AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

GALENA AIRPORT
(A.K.A. USAF GALENA AIR FORCE STATION)
GALENA, YUKON-KOYUKUK COUNTY, ALASKA
EPA FACILITY ID: AK9570028655
MAY 21, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

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

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PUBLIC HEALTH ASSESSMENT

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GALENA, YUKON-KOYUKUK COUNTY, ALASKA

EPA FACILITY ID: AK9570028655

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Foreword

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

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR have cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

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

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

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

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

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

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

Letters should be addressed as follows:

Attention: Manager, ATSDR Record Center Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

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Abbreviations

AC&WS	Aircraft Control and Warning System
ADCE	Alaska Department of Environmental Conservation
ADECD	Alaska Department of Community and Economic Development
AFB	Air Force Base
AK	Alaska
AL	action level
AS	Air Station
As	arsenic
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
Ba	barium
BTEX	benzene, toluene, ethylbenzene, and xylenes
BW	body weight
CDC	Centers for Disease Control and Prevention
CEL	cancer effects level
conc.	concentration of chemical
CPD	Community Profile Database
Cu	copper
DDX	DDE, DDD, and DDT
DRO	diesel range organics
CREG	cancer risk evaluation guides
DHHS	US Department of Health and Human Services
ED	exposure duration
EF	exposure frequency

EMEG(C, A)	environmental media evaluation guides (child, adult)
EPA	US Environmental Protection Agency
FDA	US Food and Drug Administration
Fe	iron
FPTA	Fire Protection Training Area
g	gram
GAVTC	Galena Aviation Vocational Technical Center
GRO	gasoline range organics
hr	hour or hours
IR	ingestion rate
kg	kilograms
LOAEL	lowest-observed-adverse-effects level
MCL	maximum contaminant Level
MCLG	maximum contaminant level goal
mg	milligrams
mg/m3	milligrams per cubic meter
Mn	manganese
MRL	minimal risk level
MSL	mean sea level
ND	not detected, non-detect
NOAEL	no-observed-adverse-effects level
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
Pb	lead
PCBs	polychlorinated biphenyls

PEL	permissible exposure limit
PHA	public health assessment
POL	petroleum, oil, and lubricants
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
ppmv	pars per million by volume
RBC	risk-based concentration
RfD	reference dose
RI	Remedial Investigation
RMEG(C, A)	reference dose media evaluation guides (child, adult)
SERFS	Southeast Runway Fuel Spill
SMCL	secondary maximum contaminant level
SSL	soil screening level
t½	half life of a pesticide
TCE	trichloroethylene
TEQ	Toxicity Equivalencies (PBBs)
TTHMs	total trihalomethanes
µg	microgram
µg/kg	microgram per kilogram
US	United States
USAF	US Air Force
USDA	US Department of Agriculture
USF&WS	US Fish and Wildlife Service
USGS	US Geological Survey

VOC	volatile organic compounds
WAS	White Alice Station
Zn	zinc

Summary

In 2002, the Louden Tribal Council asked the Agency for Toxic Substances and Disease Registry (ATSDR) to determine whether Air Force operations on the former Galena Air Station (AS), Campion AS, or the Kalakaket Creek White Alice Station (WAS) resulted in exposure of residents to unhealthy levels of environmental contaminants. The results of this investigation, initiated in July 2003, are presented in this report, which is known as a public health assessment (PHA).

The former Galena AS, now known as the Galena Airport, and the adjacent community of Galena, Alaska are located in west-central Alaska along the Yukon River. Galena is located on the north bank of the Yukon River and is about 340 air miles northwest of Anchorage. Construction of the airfield at Galena began in late 1941, and the site continued to operate until 1993 when it was placed in warm-standby status and returned to primarily civilian uses.

The former Campion AS was also located on the north bank of the Yukon River, approximately 6 miles east-southeast of the Galena Airport. The site consisted of about 9,963 acres located on a bluff or river terrace above the general level of the Yukon floodplain. The station was active from 1951 to 1984 and was deactivated in October 1984. The station was demolished in 1986.

The Kalakaket Creek WAS site is located about 25 miles south of Galena and south of the Yukon River. Access to the site is only by air with gravel landing strip. The site became operational in 1957 and was deactivated in 1973. The site is planned for demolition sometime between 2010 and 2011.

ATSDR met with representatives of the Louden Tribe and residents of the Galena, Alaska area during a site visit in July 2003. ATSDR gathered community input, reviewed the available site-related documents, and identified seven environmental exposure pathways for further evaluation. ATSDR also evaluated a community concern about the incidence of cancer in the community.

Human exposure to environmental contaminants released or accidentally spilled at the Galena Airport and other former Air Force installations discussed in the report can result through numerous potential pathways (routes). ATSDR reviewed the available information to determine sources of contamination, potential pathways of contaminant migration, and potential points of human exposure to those contaminants. The evaluation concluded that the Galena community has not been exposed to installation-related contaminants at levels where harm to human health has been observed. ATSDR specifically identified and evaluated five public health issues related to potential exposure to environmental contaminants. The generalized findings are summarized below. Later sections of this report describe in more detail how ATSDR reached these conclusions.

- *Is water from wells at the Galena Airport, at the Galena City Wells, or from private wells, safe to drink?* ATSDR concludes that the drinking water supplied by the Galena Airport and the city of Galena municipal systems is safe to drink. The water supplied by those systems has been safe to drink in the past and will be in the future. ATSDR concludes that the drinking water supplied by private drinking water wells in the Old Town Galena area is generally safe to drink. The levels of naturally occurring iron and manganese in certain wells are above health-based comparison values or secondary drinking water standards, but are not likely to result in adverse health effects.

- *Does the indoor air at the Galena Aviation Vocational Training Center (GAVTC) pose a health threat?* ATSDR concludes that, since beginning operations in 2002, the indoor air of the GAVTC has not been and is not now a health threat for students and teachers using the facility. If the soil gas depressurization system now in use at GAVTC continues to minimize successfully the contamination of the GAVTC indoor air, ATSDR concludes that the indoor air of the facility will be safe in the future.

- *Has the use of pesticides along roadways and other locations subject to pesticide control resulted in harmful levels of human exposure to those substances?* ATSDR concludes that the pesticides detected in surface soils and sediments at the Galena Airport and the former Campion Air Station are not of human health concern for children or adults. ATSDR also concludes that the available data and indirect evidence indicate that the residents of Old Town Galena have not been exposed to pesticide contaminants at levels that would result in harmful health effects.

- *Have petroleum compounds released from Million Gallon Hill (MGH) migrated towards the former Southwest Landfill area and are those contaminants potentially resulting in human exposure to contaminants at a harmful level?* ATSDR concludes that the environmental contaminants released from the Million Gallon Hill (MGH) have not resulted in human exposures to those contaminants in the area east of the MGH. The nearby former Southwest Landfill area has not been affected by MGH contaminants. These sites are not pathways of human exposure to environmental contaminants. There is no evidence that contaminants within this landfill have migrated to the Yukon River.

- *Have releases of contaminants from the former Galena Air Station, the Campion Air Station, or the Kalakaket Creek White Alice System Station resulted in contamination of the traditional subsistence food-chain components?* After reviewing the available evidence, ATSDR concludes that the environmental contamination found at the Galena Airport, the Campion AS, and the Kalakaket Creek WAS site is not now and was not in the past a local source of food chain contamination. ATSDR concludes that the Yukon River salmon harvested by the residents of the Galena area are safe to eat. ATSDR also concludes that burbot and northern pike are safe to eat, if consumed in small quantities during the year.

Details regarding ATSDR's findings and the reasons supporting them are documented throughout this report.

Introduction

In July 2002, the Louden Tribal Council asked the Agency for Toxic Substances and Disease Registry (ATSDR) to determine whether hazardous substances released from the operations previously conducted at the United States Air Force [1] (USAF) Galena Air Station (AS), now known as the Galena Airport, the nearby Campion AS, and the Kalakaket Creek White Alice System (WAS) sites pose a public health threat. During July 8–10, 2003, ATSDR conducted an initial site visit to Galena, Alaska, to meet with the tribal council, tour the Galena and Campion sites, and gather available environmental data. It was not possible to visit the Kalakaket Creek WAS site, but information was gathered on that site as well. As a result of this site visit and an initial review of the available environmental documents, ATSDR initiated an evaluation of public health concerns related to USAF activities in the Galena area.

ATSDR is responding to this request in a document known as a public health assessment (PHA). This PHA examines chemicals that enter the environment, how they move through the environment, and the levels that residents might encounter. ATSDR then uses this information to determine whether individuals exposed to levels of contamination might experience health problems.

This PHA addresses the public health implications of potential human exposure through ingestion, inhalation, or dermal contact to environmental releases of contaminants to the water, surface soil, air, and food chain. More details about the evaluation of potential pathways of human exposure to chemicals released to the environment can be found in the Evaluation of Exposure Pathways section of this PHA.

An important aspect of the PHA process is defining and addressing health concerns of community members. Throughout the PHA process, ATSDR has been, and will continue to work with the community to define specific public health issues and community concerns. Discussion with community members has also helped define ways in which ATSDR can provide educational materials and information to help protect the public health of Galena residents.

ATSDR recognizes that Alaska Natives have inhabited this land for many years. Traditional wisdom and practices have been passed down from generation to generation. The way many Alaska Natives relate to this land is shaped by these traditions. Significant changes to the use of some of these lands and to the population, in general, began in the 1900s and continue today. Many Alaska Natives are concerned that these changes could have had harmful effects on their health and wellbeing. This PHA is an objective, scientific evaluation which will, hopefully, resolve some of these concerns.

Background and Site History

Galena, Alaska

The former Galena AS and the adjacent city of Galena, Alaska are located in west-central Alaska along the Yukon River (64° 44’ N Latitude, 157° 53’ West Longitude). Galena is about 340 air miles northwest of Anchorage and about 270 air miles west of Fairbanks (Figure 1). The

1 The U.S. Army Air Corps originally developed the Galena Air Station. Under the National Security Act of 1947 the Army Air Corps became the U.S. Air Force.

community of Galena is located on the north bank of the Yukon River in an area known as the Koyukuk Flats region — an extensive lowlands region covering about 4,000 square miles at the confluence of the Yukon and Koyukuk Rivers.

The Koyukuk Flats are characterized by numerous oxbow lakes (i.e., cutoff river-meanders), bogs or sloughs, and dry lakes. The dry lakes are underlain by well-drained soils without underlying permafrost (permanently frozen) ground. The vegetation of the region consists mostly of typical boreal forest which is comprised of black spruce bogs on poorly drained soils, low brush bogs which include tamarack, rose, grasses, sedges, rushes, fireweed, berries, mosses, and lichens, and local stands of cottonwood and white spruce.

Locally, periodic wildfires have modified the boreal forest resulting in stands of aspen, birch, and willow. Those willow stands created by re-growth after fire and the willow stands developed on recent deposits of the Yukon River support high population densities of moose — one of the traditional food sources for local residents.

A U.S. Air Force historical review (USAF 2000) reveals that Galena was officially established in 1918. In 1919, prospecting for lead in the area resulted in the founding of a small mining supply and lead-ore shipping center at Galena. Beginning in 1920, the Koyukon Athabascan people, who lived upriver at Louden, moved to Galena. Early in the 1920s a school was established at Galena, and a post office was established in 1932 (ADCED 2003).

The original Galena town site (now known by many as Old Town) is located on the north bank of the Yukon River and is subject to frequent flooding by the river. Of the nine major historic floods, the highest on record occurred on May 23, 1971, when Old Town was inundated with about 8 feet of water and floating ice blocks resulting in extensive damage (Waterhouse 1996).

The major flood of 1971 coincided with the passage of the Alaska Native Claims Settlement Act (ANCSA) by Congress (Dames & Moore 1999). The passage of ANCSA resulted in formation of the village corporations. Those corporations received funds and title to lands as part of the claim settlement process. The opportunity presented by the ANCSA settlement prompted the residents of Old Town to plan for expansion in the Alexander Lakes area located at a higher elevation to the east of Old Town and the Galena AS. The Alexander Lakes Subdivision was established by the city of Galena and lots were sold to the public. By 1978 a number of homes, a new medical clinic, and a high school were constructed in the Alexander Lakes Subdivision (now known to some as New Town). A sanitary sewer system for municipal buildings and the school and a municipal water system were established in the subdivision in the 1980s (Dames & Moore 1999). The water supply system now includes two wells (approximately 300 feet deep) and a treatment plant system. The piped water system serves many homes and the municipal buildings (Louden Tribal Council 2003).

The Galena Air Station

The Civil Aeronautics Authority (CAA) began construction of an air field at Galena in late 1941 as a part of a larger civilian airport construction program throughout Alaska. After the attack on Pearl Harbor on December 7, 1941, Alaska's National Guard was pressed into federal service, leaving most of the interior and western coastal regions with inadequate protection. Alaska's Governor Ernest Gruening received permission from Congress to form a volunteer civilian military to protect the vast territory of Alaska, and the Alaska Territorial Guard (ATG) came into being. During this time, most able-bodied civilians not central to the war effort were provided firearms to help in the protection of the territory.

On June 3 and 4, 1942, Japanese forces began their invasion of the Aleutian Islands portion of the Alaskan Territory. As regular U.S. Forces flooded into the Aleutians to repel the invaders, the defense of much of the remainder of Alaska fell to the ATG. It was also at this time that the U.S. Army began to expand its build-up of facilities in Alaska to support the military campaign in the Aleutians and support for the Lend-Lease shipments to the Soviet Union. In June 1942, the U.S. Army established a post at Galena and began construction of new facilities to support military operations at the airport. The Galena AS was established when the newly constructed facilities were officially transferred from the CAA to the U.S. Army in July 1943 (USAF 2000).

From 1942 to 1945 the Galena AS served as an auxiliary airfield for refueling and maintenance of many aircraft en route to Nome and then on to the Soviet Union. From 1943 to1945, the Army constructed numerous facilities at the Galena AS, including the large Birchwood hangar (now demolished and removed) adjacent to the runway. In 1944, Galena AS was flooded by the Yukon River and many of the site facilities were damaged. As a result, an earthen dike was constructed around the Galena AS in 1944 but, on May 24, 1945, the Galena AS was again flooded and many facilities destroyed or damaged (USAF 2000).

Galena AS was declared surplus following the end of World War II and was transferred back to the CAA in December 1945. No sooner was the threat in the Japanese theater ended than the threat from the Soviet Union emerged and the Cold War began. The U.S. Air Force began the development of a variety of defensive facilities throughout Alaska which, early in 1951, included an agreement with the CAA for joint civilian-military use of the Galena Airport. The northernmost forward operating base for fighter-interceptors was established at the Galena AS to meet the threat of Soviet bombers and fighter aircraft. During the 1950s through 1989, several additional facilities, including a Combat Alert Cell Hangar, barracks, and a headquarters building were constructed to support the fighter-interceptor mission of the installation (USAF 2000).

During this Cold War period, in compliance with the Alaska Statehood Act of 1958, the airport was transferred from the CAA to the state of Alaska in 1966. However, the US Air Force retained control of the land on which the airport facilities were constructed. The Galena AS continued to operate as a forward operating base until 1993 when the AS was placed in warm standby status and returned to primarily civilian uses (USAF 2000; ADCED 2003). The Galena AS is now known as the Galena Airport. Old Town Galena is located immediately south of the airport, (see Figures 1A, 2, and 2A).

The Campion Air Station

The former Campion AS was also located on the north bank of the Yukon River approximately 6 miles east-southeast of the Galena Airport (see Figures 3 and 3A). The site consisted of about 9,963 acres located on a bluff or river terrace above the general level of the Yukon floodplain. Campion AS was constructed in 1951–1952, became operational in April 1952, and was deactivated in October 1984 (USAF 2003a). Campion AS served as a long-range, ground-control intercept radar station — part of the Aircraft Control and Warning System (AC&WS) (DoD 1998). The station was active from 1951 to 1984 The station was replaced by a minimally attended, long-range radar facility at the Galena Airport (DoD 1998).

The Campion AS originally consisted of radar domes; radio towers; a petroleum, oil, and lubricants (POL) tank farm; and support facilities. A barge landing-site for off-loading POL and other supplies was located about 1.5 miles northwest of the site, near the mouth of Beaver Creek. Additionally, a 7,250 foot gravel runway intended as an auxiliary runway to the Galena AS and which would accommodate as many as 16 additional aircraft was to serve Campion AS as well. However, the expansion plans were cancelled and the field was deactivated in 1954. Campion AS was demolished by the US Air Force in 1986 (DoD 1998). Four fuel tanks remained at the site until they were removed in 1989 (USAF 2003a).

The Kalakaket Creek White Alice Station

The Kalakaket Creek WAS site is located about 25 miles south of Galena, south of the Yukon River (Figure 4). The station was part of the White Alice Communication System (WACS) developed in the 1950s. Although the origin of the term "White Alice" is in dispute, the WCAS stations linked the AC&WS sites and the Distant Early Warning sites (DEW-line sites) into a single, cohesive network that relayed communications back to Alaska's Elmendorf and Eielson Air Force Bases.

The Kalakaket Creek WAS site became operational in May 1957 as one of 33 original WACS sites (CH2M HILL 1993; USAF 2001). The site included a composite building with dormitories, office and storage space, and equipment for a standby power generator; four 'billboard' antennas and feed horns (White Alice arrays); two microwave antennas; storage and distribution facilities for POL; an equipment-maintenance building; a temporary garage; a water supply cistern, pumps and supply lines; and an airstrip (CH2M HILL 1993, USAF 2001). The lands surrounding the site are federal lands managed by the Bureau of Land Management.

The development and implementation of satellite communications in the late 1960s made the WACS obsolete and the Kalakaket Creek WAS site was deactivated in 1973. The USAF currently plans to demolish the site facilities sometime between 2010 and 2011 (USAF 2001).

Topography and Land Use

Because three geographically separate and distinct sites are considered in this PHA, the following discussion describes the characteristics and topography of each site separately, simply noting the geographic location of one site to another.

Former Galena Air Station – Galena Airport

The former Galena AS is located on the banks of the Yukon River and immediately adjacent to Old Town Galena, Alaska (see Figures 2 and 2A). The site lies on the floodplain of the Yukon River at an elevation of about 120 feet above mean sea level (MSL).

Given the annual flooding potential of locations in close proximity to the Yukon River, additional growth of Galena has occurred in an area above the immediate threat of the spring-time flooding of the Yukon. The residences and other development in the new portions of Galena (New Town), which began in 1978, are located northeast of the airport, approximately 1 mile upriver and upgradient of any potential releases of contaminants from the airport facility.

Because of the problems presented by the flooding of the Yukon River in 1944, a perimeter dike was constructed around the former Galena AS. That dike, as tall as about 16–20 feet, separates the Galena Airport from Old Town. The dike has — for the most part — protected the Galena Airport facilities from flooding and also served to contain the runoff of surface waters within the diked area that are generated by precipitation or snowmelt.

Campion Air Station

Campion AS facilities were located at an elevation about 390 feet above MSL and about 6 miles east-southeast of the Galena Airport on a gently rolling upland river terrace area above the Yukon River (Figures 3 and 3A). The location of the site facilities (now destroyed) on the north bank of the Yukon River are illustrated in those figures. The site and the former site facilities are far removed from the influences of flooding along the river with the exception of the Barge Landing Area located on the banks of the Yukon River.

Kalakaket Creek White Alice Station

The former Kalakaket Creek WAS site encompasses about 316 acres and is located about 25 miles south of Galena, across the Yukon River. Access to the site is only by air, with a 4,090-foot gravel landing strip sited at about 1600 feet above MSL. The landing strip is connected to the site by a one mile gravel road. The water supply cistern is located downhill to the east approximately 0.8 mile. The WACS site facilities lie on a fairly level mountaintop at about 1,950 feet above MSL. The site and the support facilities are shown in Figure 4. Kalakaket Creek is a north-flowing creek about 2 miles west of the site. Kalakaket Creek drains to Kala Creek which is tributary to the Yukon River.

Demographics

ATSDR examines demographic data (i.e., population information) to determine the number of people potentially exposed to environmental chemicals, and to determine the presence of any sensitive populations, such as women of childbearing age, children, and the elderly. Demographic data also provide details on population mobility which, in turn, helps ATSDR evaluate how long residents might have been exposed to environmental chemicals.

Figure 5 incorporates a table that summarizes the 2000 US Census Bureau demographic data for Galena. As the table shows, the 2000 Census reported that 514 people live within 1 mile of the Galena Airport site. This table also specifies the number of residents in three potentially sensitive populations: women of childbearing age, children, and the elderly. According to several anecdotal accounts, the population of Galena is not highly mobile; many are lifelong residents of the area.

Climate

The area experiences a cold, continental climate with extreme temperature differences. During the 1947 to1984 reporting period, the reported average daily high temperature during July is 60° Fahrenheit (F); the average daily low temperature during January is -11°F. Sustained temperatures of -40°F are common during the winter. The measured temperature extremes range from -64°F to 92°F (USAF 1996).

The average annual precipitation is 12.7 inches, including an average of 60 inches of annual snowfall (USAF 1996). The Yukon River is normally ice-free from mid-May thru mid-October. Spring-time flooding of the Yukon floodplain is commonly associated with the development of ice-jams along the river during the annual breakup of river ice. Historically, bombing or the use of explosive charges has been used to help breakup and remove those ice-jams and lessen flooding problems.

Geology, Hydrogeology, and Water Use

Galena Airport Geology

The former Galena AS, now the Galena Airport [2] is located within the floodplain of the Yukon River and is underlain by alluvial deposits (see text box for definition) deposited by the river as the meandering channel shifts from side to side across the floodplain area. The Yukon River is characterized by large (5 to 6-fold) seasonal variations in discharge and the quantity and kinds of sediment transported by the flow of the river.

> Alluvial deposits are sediments deposited by flowing water.

The geology of the Galena area is summarized in detail in the Remedial Investigation (RI) Report for the Galena Airport and the Campion AS (USAF 1996) and in the Galena Airport, Draft Environmental Monitoring Report, No. 7 (USAF 2002). The following discussion summarizes the more detailed discussion of this topic in the RI.

Throughout the year, sand, gravel, and cobbles are transported along the bed of the river as a shifting bed and bars within the river channel. These coarse, grain-sized, poorly sorted or heterogeneous sediments are called the bedload of the river. Deposits that result from bedload are called bedload deposits. During the spring and summer, sediments (largely sand and silt) are suspended by the rapid, turbulent flow of the river. When deposited, they result in medium to fine grain-sized suspended sediments that could be well-sorted (i.e., more uniform in size) deposits of sand or silt or heterogeneous deposits of sand and silt. These deposits could also contain partially decomposed organic material from surface vegetation.

During periods of peak and flood flow during the spring and early summer, the Yukon River erodes the banks of the channel, resulting in lateral migration of the main channel and the development of chute cutoffs. The result is the reworking of previously deposited alluvial sediments and the re-deposition of those sediments further downriver. Over time, the Yukon River has not only migrated laterally, but it has built-up or accumulated this complex assemblage of coarse- and fine-grained deposits to a thickness of more than 200 feet beneath the Galena Airport (USAF 1996; USAF 2002).

These unconsolidated, alluvial sedimentary deposits are generally comprised of an ascending sequence of silty sand, sand, gravel, and cobble bedload deposits overlain by about 3 to 25 feet of stratified layers of silt and sand. These deposits are typically lens-, wedge-, or string-shaped. Thus these deposits are often markedly thicker or thinner, depending on where they are examined (USAF 1996).

2 The name Galena Airport will appear in the following sections of the report unless it becomes important to distinguish some action or event that occurred during the time the facility was the Galena AS.

During the construction of the Galena AS and its subsequent improvements, man-made fill deposits were placed on top of the natural floodplain deposits to permit the construction of the facilities. The dike constructed to protect the former Galena AS from flooding of the Yukon River is constructed of a thick prism of fill material.

Test borings completed during the development of the RI have found silty gravel and poorly graded gravel ranging in thickness from 0 to 6.5 feet in the northern part of the airport. Fill material in the area of the Million Gallon Hill is about 20 feet in thickness.

Several test borings and pits completed at the Galena AS during the 1950s and 1960s found permafrost (permanently frozen ground) at various depths. The permafrost was found either as near-surface, isolated lenses, or as continuous layers 20 feet or more below the surface. The USAF (1996) RI reports that continuous permafrost is usually present at about 10 feet below the ground surface, where the natural vegetation of the floodplain remains undisturbed (USAF 1996: USAF 2002).

During the construction of the Galena AS, the natural vegetation was removed. Gravel pads were constructed to prevent unacceptable settlement and damage to structures caused by melting of the subsurface permafrost and the subsidence of the compressible alluvial soils. However, subsequent subsurface investigations conducted by the USAF (1996) indicate that the occurrence of permafrost is now sporadic, and permafrost might be absent to depths or 60 feet or more. In airport areas closer to the Yukon River, the occurrence of permafrost is increasingly more sporadic (USAF 1996; USAF 2002).

Galena Airport Hydrogeology

Old Town Galena and the Galena Airport are situated on the banks of the westward flowing Yukon River. Variations in the stage or flow level of the river have a large effect on the groundwater of the porous and permeable alluvial deposits underlying the site.

The maximum low-water level of the Yukon River is typically in early May, before the spring breakup of ice on the river. The river stage rises abruptly with the warming temperatures, the breakup of the ice, and the increased discharge from the melting snow pack. The occurrence of ice jams could also temporarily increase the local river stage at this time. Peak water levels or flood-flow of the Yukon River generally occur in late May or early June. The river stage declines during the summer months, except when rainstorms contribute additional surface water runoff to the river. The Yukon River returns to low-flow conditions with the onset of the river freeze-up (USAF 2002).

Groundwater at Galena exists as an unconfined, alluvial aquifer. This aquifer is comprised of the unconsolidated gravel, sand, and minor amounts of silt alluvium deposited by the Yukon River. These floodplain deposits are as thick as 200 feet in the Galena area. The depth to the water table varies seasonally from about 5 to 25 feet below the ground surface, with the seasonal fluctuation in the changes in the stage or level of the Yukon River (USAF 1996; USAF 2002).

It is possible that permafrost was more continuous beneath the former Galena AS in the early years shortly after the initial construction of the facility. If in the past a reasonably continuous permafrost layer existed in the alluvium, it could have locally influenced the level of the water table and the flow of groundwater within the alluvium. Scientific investigations of the character of the groundwater beneath the Galena Airport, such as the RI (USAF 1996) and the investigations summarized in the Environmental Monitoring Report No.7 (USAF 2002), were made during a time when, as indicated by subsurface borings, permafrost is largely absent and now occurs only in localized areas. Thus, while groundwater flow conditions might have been somewhat different in the past, because of permafrost in the alluvium the basic groundwater flow characteristics discussed in the following discussion not only accurately describe the current conditions, but also qualitatively describe the behavior of groundwater flow in the past.

During peak or flood-flow stages of the Yukon River in the spring and early summer, some of the river water seeps into the banks of the river channel and recharges the groundwater, resulting in a rise of the water table. When the river stage begins its progressive decline, the water table also begins to drop as groundwater in the alluvium discharges back into the river. Localized variations in water table elevation or flow direction could occur due to complex variations in the grain-size and shape of the individual sedimentary deposits that make up the aquifer (USAF 2002).

The USAF (1996) measured the seasonal variations of groundwater flow rate and flow direction at the Galena Airport in observation wells drilled about 1,400 feet north of the Yukon River. Measurements were obtained during a period of peak-flow and a high stage of the Yukon River (May 25–28, 1993) and during a low stage of the river (August 21–24, 1993). During the April time period, when the Yukon River was at a high stage, the groundwater flow direction was towards the north (away from the river) at flow velocities ranging from 1 to 5 feet/day. The most rapid groundwater flow at this time occurred near the top of the aquifer. In August, during a summertime low river stage, the measure flow direction had reversed and was now towards the southwest (towards of the river) at velocities ranging from 1 to 11 feet/day. During this time, the most rapid groundwater flow velocities were measured in deeper beds within the coarser-grained beds such as gravel or coarse sand beds (USAF 1996).

Measurement of the elevation of the water table at several locations across the Galena Airport using more than 20 monitoring wells was gathered from 1993 to 2001. Those data show that groundwater flows to the north in May and June and to the southwest (towards the Yukon River) across the Galena Airport from July to April of each year. It is likely that this northerly flow of groundwater from the Yukon River in May or June meets the prevailing groundwater flow to the southwest, which temporarily results in an accumulation or "ponding" of the groundwater underneath the airport. That "ponded" groundwater could temporarily show no discernable flow direction or velocity until the regional southwest flow is reestablished.

Water Use in the Galena Area

Currently, the residents of Old Town receive their drinking water from water trucked-in from the Galena Airport, from the city of Galena wells located in New Town, or from at least 7 private water wells serving about 10 residences and the laundromat. The municipal buildings, New Town school, and perhaps 20 or more residences are served by the city-supplied water piped from the municipal water wells and treatment system. Other New Town residents rely on trucked water.

The water produced by the two city wells and the two airport wells are routinely subject to water quality monitoring consistent with the requirements imposed on public water supply systems by the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental

Conservation (ADEC 2003a). Both systems met all EPA and ADEC drinking water health standards in 2002 (Beasley and Settles 2003; Mackey 2003).

The Louden Tribal Council (2003) reports that in Galena (Old and New Towns combined), more than half of the homes use a flush-haul system (i.e., storage tank contents are collected and trucked to the city sewage lagoon for disposal), about one-fourth use septic tank systems; and the remainder of the un-sewered residences rely on outhouses or honey buckets.

Campion Air Station Geology

The Campion AS is located on the alluvium of an abandoned river terrace, elevated above the floodplain of the Yukon River. The local subsurface conditions have been determined through the drilling of four monitoring wells and two soil borings. The monitoring wells penetrated the subsurface to depths of 15, 16.5, 20, and 54.5 feet (USAF 1996).

These borings disclose that the area underlying the facilities and housing area of the now-demolished Campion AS are, beginning at the present ground surface, comprised of about 5 feet of poorly graded gravelly silt to gravelly sand. Underlying this man-made fill unit is a deposit of sandy silt and sand that contains lenses of decomposing woody plant material. Underlying that unit is an organic-rich, dark-colored clayey silt, which ranges in thickness from about 1.5–5 feet. This clayey silt unit appears to correlate with the deposit immediately underlying the marshy area at the base of the bluff to the west of the former Campion AS. Underlying the clayey silt unit is the lowest deposit penetrated by borings. That deposit is comprised of sand that appears to grade laterally — away from the Yukon River — to silty sand in the northeastern part of the Campion AS site (USAF 1996).

Continuous permafrost was encountered in the borings at about 50 feet below the surface of the area developed for the Campion facilities and at depths ranging from about 10.5–21 feet below the low-lying marshy area to the west of the former Campion AS. This continuous permafrost layer could be a lower confining layer for shallow groundwater flow (USAF 1996).

Campion Air Station Hydrogeology and Water Use

The groundwater hydrology of the site is partially described in the RI (USAF 1996). In the north and northeastern portions of the site, near POL storage tanks, the groundwater flow is to the west (generally away from the Yukon River), towards the low, marshy lands located there. Under much of the site the depth to the top of the water table appears to be about 18–19 feet.

The drinking water supply for Campion AS was from one or more wells. It is presumed that the well was, or the wells were, plugged and abandoned when the site facilities were removed. Still, ATSDR has not located records to confirm this well abandonment. ATSDR also has not located documents describing the quality of the drinking water from these wells. However, it is USAF policy to have provided safe drinking water by following the state or federal drinking water standards in effect at the time.

Kalakaket Creek White Alice Station Geology

A Preliminary Assessment (PA) report prepared by the Hazardous Materials Technical Center (HMTC 1989) and a 1993 Draft PA prepared by CH2MHILL (1993) summarized the geology of

Metamorphic rocks are any rocks that have been changed in form or structure. Locally, a dense complex of jointed, fractured, and sheared crystalline rocks.
Igneous rocks are any rocks that formed from the crystallization and solidification of molten magma or lava.

the Kalakaket Creek WAS site. The following summary of the Kalakaket Creek WAS site geology is based on a more detailed discussion of this topic given in those sources.

The Kalakaket Creek WAS facility is sited on a fairly broad topographic high underlain by a complex of metamorphosed igneous rocks (see text boxes for definitions). These rocks are comprised of a dense complex of jointed, fractured, and sheared crystalline rocks. Locally, the metamorphic bedrock is mantled by a variable thickness of gravelly soils. The USAF (2001) reports that the site is underlain by less than 1 to 7 ft. of boulders, cobbles, and gravel, with some silt in the lower portion of the soil profile. It is unlikely that groundwater exists beneath the Kalakaket Creek WAS site (USAF 2001). Whether permafrost occurs below the surface is unknown.

Kalakaket Creek WACS Water Use

The records (CH2M HILL 1993; USAF 2001) document that a cistern system was used to supply drinking water to the Kalakaket Creek WAS site. It is presumed that this cistern system will be removed or otherwise closed when the site facilities are removed. ATSDR has not located documents describing the quality of this drinking water supply, but as previously noted, it is the policy of the USAF to supply safe drinking water by following the state or federal drinking water standards in effect at the time.

ATSDR Involvement at Galena

Site visits

Between July 7 and July 11, 2003, ATSDR conducted a site visit to Galena, Alaska. The purpose of the visit was to begin collecting information necessary for conducting a PHA and to determine if immediate public health actions were needed. To identify any potential public health concerns, we reviewed available site-specific information and visually inspected the current designated waste sites or other areas where hazardous substances have been released to the environment. Additionally, ATSDR staff met with USAF environmental personnel and with representatives of federal, state, and local agencies. As a result of these meetings and a preliminary survey of the data currently available, several issues and community concerns were identified that have been evaluated in this PHA.

As a follow-up to the site visit, ATSDR prepared and distributed a brief public health consultation (ATSDR 2003) summarizing the site visit findings and identifying the issues that ATSDR intended to evaluate when preparing the public health assessment for the Galena Airport.

Community Involvement

Before the site visit, an ATSDR representative participated by telephone in a Galena Airport Restoration Advisory Board meeting. From that meeting ATSDR learned about the status of the ongoing site investigations and began to identify potential issues of concern.

During ATSDR's site visit to Galena, Alaska, an informal public availability session was held July 9–11, 2003. Members of the site-visit team were available at the Louden Tribal offices for members of the Tribe and other members of the community to share their health concerns and their observation on site history and significant events. About one dozen community members were interviewed at this time. On a local radio program, ATSDR representatives described the public health assessment process now underway and invited community members to meet with ATSDR representatives and express their health concerns. Members of the team visited the health clinic and also visited local gathering places to talk informally with members of the community.

Health Education

During the week of May 3, 2005, representatives of the ATSDR Division of Health Education and Promotion made a brief visit to Galena. The objectives of that visit were to meet with representatives of the health clinic Louden Tribe and to assess further local health education needs.

Based upon the input received during the May meeting, ATSDR returned to Galena and provided primary care provider training on August 30, 2005. That training is summarized later in this assessment.

Quality Assurance and Quality Control

To prepare this PHA, ATSDR reviewed and evaluated information provided in the referenced documents. The limitations of these data have been identified in the associated reports, and are restated in this document, as appropriate. The sampling procedures, analytical methods, and detection limits established for those investigations were consistent with the studies' objectives. For some of the data, quality assurance and quality control measures were not available.

ATSDR determined that the quality of environmental data available in the Galena, Campion, and Kalakaket site-related documents, unless noted to the contrary, constitute an adequate basis for public health decisions or recommendations. All available sampling data were considered during the public health assessment process.

Evaluation of Exposure Pathways

The five elements of an exposure pathway are

- (1) source of contamination,
- (2) environmental media,
- (3) point of exposure,
- (4) route of human exposure, and
- (5) receptor population.

The source of contamination is where the chemical was released. The environmental media (e.g., groundwater, soil, surface water, air) transport the chemical. The point of exposure is where humans come in contact with the contaminated media. The route of exposure (e.g., ingestion, inhalation, dermal contact) is how the chemical enters the body. The receptor population is the person or persons actually exposed.

Introduction: What Does "Exposure" Mean?

ATSDR's PHAs are driven by an evaluation of the potential for some type of human contact or exposure to environmental contaminants. Although chemicals released into the environment have the potential to cause harmful health effects, a release does not always result in exposure. People can only be exposed to a chemical if they breathe, eat, drink, or come into skin contact with that chemical. If no one comes into contact with a chemical, then no exposure occurs, thus no health effects could occur. Often the general public does not have access to the source area of the environmental release; this lack of access becomes important in determining whether the chemicals are moving through the environment to locations where people could come into contact with them

The route of a chemical's movement is the pathway. ATSDR identifies and evaluates exposure pathways by considering how people might come into contact with a chemical. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical.

A completed pathway exists when the five elements of a pathway connect a source of contamination to a receptor population. If contaminants migrate from a source area to a point where people can contact them, a completed pathway of exposure could exist. In addition, completed pathways are likely to occur when people enter source areas. A potential pathway exists when information for one of the five elements is unknown or missing.

Exposure does not always result in harmful health effects. The sections below describe the conditions under which harmful effects might be expected to occur.

How Does ATSDR Determine Which Exposure Situations to Evaluate?

ATSDR scientists evaluate site-specific conditions to determine whether people are being exposed to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, water, air, waste, or biota) is occurring through ingestion, dermal (skin) contact, or inhalation. Figure 6 describes ATSDR's exposure evaluation process.

If exposure is possible, ATSDR scientists then consider whether contamination is present at levels that might affect public health. ATSDR scientists select chemicals for further evaluation by comparing them against health-based comparison values. Comparison values (CVs) are developed by ATSDR from available scientific literature concerning exposure and health effects. CVs are derived for each of the media and reflect an estimated chemical concentration that is not expected to cause harmful health effects for a given chemical, assuming a standard (typical or average) daily contact rate (e.g., amount of water or soil consumed or amount of air breathed) and body weight.

Comparison values are not thresholds for harmful health effects. ATSDR's CVs represent chemical concentrations many times lower than levels at which no effects were observed in experimental animal or human epidemiologic studies. If chemical concentrations are above CVs, ATSDR further analyzes exposure variables (e.g., duration and frequency) for health effects, including the toxicology of the chemical, other epidemiology studies, and the weight of evidence.

Some CVs used by ATSDR scientists include ATSDR's environmental media evaluation guides (EMEG), reference dose media evaluation guides (RMEG), and cancer risk evaluation guides (CREG). EMEGs, RMEGs, and CREGs are non-enforceable, health-based comparison values developed by ATSDR for screening environmental contamination for further evaluation. Risk-based concentrations (RBCs) and soil-screening levels (SSLs) are health-based comparison values developed by EPA Region III to screen sites not yet on the National Priorities List (NPL), respond rapidly to citizens' inquiries, and spot-check formal baseline risk assessments. Appendix A describes the CVs used in this PHA.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual (1992) at http://www.atsdr.cdc.gov/HAC/HAGM or by contacting ATSDR at 1-888-42-ATSDR. Appendix B defines some of the technical terms used in this health assessment.

If Someone is Exposed, Will They Get Sick?

Exposure Does Not Always Result in Harmful Health Effects.

The type and severity of health effects that occur in an individual as the result of contact with a chemical depend on the exposure concentration (how much), the frequency and duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of chemicals). Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how that individual absorbs, distributes, metabolizes, and excretes the chemical. Taken together, these factors and characteristics determine the health effects that can occur as a result of exposure to a chemical in the environment.

Considerable uncertainty exists regarding the true level of exposure to environmental contamination. To account for that uncertainty and to protect public health, ATSDR scientists often use high-end, worst-case exposure level estimates (e.g. maximum concentrations detected or maximum durations of exposure) to determine whether harmful health effects might be possible.

Methods Used to Evaluate Public Health

Overview

An Exposure Dose is the Amount of Chemical a Person is Exposed to Over Time.

To evaluate exposures to contaminants, ATSDR examined available data to determine whether chemicals were above ATSDR's CVs. For those that did exceed CVs, ATSDR derived exposure doses (see the following discussion for a definition) and compared them against health-based guidelines. ATSDR also reviewed relevant toxicological data to obtain information about the toxicity of chemicals of interest. As stated previously, exposure to a certain chemical does not always result in harmful health effects. The type and severity of health effects expected to occur depend on the exposure concentration, the frequency and duration of exposure, the route or pathway of exposure, and the multiplicity of exposure.

Comparing Data to ATSDR's Comparison Values

Comparison values are derived using conservative (e.g. maximum and, therefore, highly protective) exposure assumptions, reflecting concentrations much lower than those observed to cause harmful health effects. Thus, CVs are protective of public health in essentially all exposure situations. As a result, concentrations detected at or below ATSDR's CVs do not warrant health concern. While a concentration at or below the relevant CVs could reasonably be considered safe, it does not necessarily follow that any environmental concentration exceeding a CV would produce harmful health effects. It cannot be emphasized too strongly that CVs are not thresholds of toxicity. The likelihood that harmful health outcomes will actually occur depends on site-specific conditions and individual lifestyles, as well as genetic factors affecting the route, magnitude, and duration of actual exposure — not an environmental concentration alone.

The majority of chemicals detected in the environmental media sampled at Galena and the other sites were at or below CVs and not further evaluated. Chemicals above CVs were considered for further evaluation, prompting ATSDR to estimate exposure doses using site-specific exposure assumptions.

Deriving Exposure Doses

ATSDR derived exposure doses for those chemicals detected above ATSDR's CVs. Exposure doses are expressed in milligrams per kilogram per day (mg/kg/day). When estimating exposure doses, health assessors evaluate chemical concentrations to which people could have been exposed, together with the length of time and the frequency of exposure. Collectively, these factors influence an individual's physiological response to chemical exposure and potential outcomes. Where possible, ATSDR used site-specific information regarding the frequency and duration of exposures. When site-specific information was not available, ATSDR employed several highly protective exposure assumptions to estimate exposures. For example, the following equation estimates incidental ingestion of chemicals in water:

$$Estimated\ Exposure\ Dose = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

C: Concentration of chemical in parts per million (ppm, which is also mg/L)

IR: Ingestion rate: adult = 2 L/day; child = 1 L/day

EF: Exposure frequency, or number of exposure events per year of exposure: 365 days/year

ED: Exposure duration: adult = 70 years; child = 6 years

BW: Body weight: adult = 70 kilograms (kg); child = 10 kg

AT: Averaging time, or the period over which cumulative exposures are averaged (6 years or 70 years x 365 days/year)

Using Exposure Doses to Evaluate Potential Health Hazards

ATSDR analyzes weight of evidence to determine whether exposures might be associated with harmful health effects (noncancer and cancer). As part of this process, ATSDR examines relevant toxicologic, medical, and epidemiologic data to determine whether estimated doses are likely to result in harmful health effects. As a first step in evaluating noncancer effects, ATSDR compares estimated exposure doses (calculated using maximum concentrations) to conservative, highly-protective, health guideline values, including ATSDR's minimal risk levels (MRLs) and EPA's reference doses (RfDs). The MRLs and RfDs are estimates of daily human exposure to a substance that are unlikely to result in noncancer effects over a specified duration. Estimated exposure doses less than these values are not considered to be of health concern. To maximize human health protection, MRLs and RfDs have built in uncertainty or safety factors, making these values considerably lower than levels at which health effects have been observed. The result is that even if an exposure dose is higher than the MRL or RfD, it does not necessarily follow that harmful health effects will occur.

But if health guideline values are exceeded, ATSDR examines the health effects levels discussed in the scientific literature and more fully reviews exposure potential. ATSDR reviews available human studies as well as experimental animal studies. This information is used to describe the disease-causing potential of a particular chemical and to compare site-specific dose estimates with doses shown in applicable studies to result in illness (known as the margin of exposure). For cancer effects, ATSDR compares an estimated lifetime exposure dose to available cancer effects levels (CELs), which are doses that produce significant increases in the incidence of cancer or tumors, and reviews genotoxicity studies to understand further the extent to which a chemical might be associated with cancer outcomes. This process enables ATSDR to weigh the available evidence in light of uncertainties and offer perspective on the plausibility of harmful health outcomes under site-specific conditions.

When comparing to actual health effects levels in the scientific literature, ATSDR tries to estimate more realistic exposure scenarios to use for comparison. In this level of the evaluation, if there are a large number of detections, an average concentration [3] is used to calculate exposure doses to estimate a more probable exposure. It most cases it is highly unlikely that anyone would ingest or inhale the maximum concentration of a chemical in the water, surface soil, air, or food on a daily basis and for an extended period of time.

If a large amount of analytic data is unavailable, ATSDR sometimes uses the maximum concentration to calculate the exposure dose to identify if potential adverse health effects might result from that dose. ATSDR recognized the hi-bias of this approach and also recognizes that this approach is highly protective of public health.

Therefore, the estimated exposure levels are usually much higher than the levels to which people are really exposed. If the exposure levels indicate harmful health effects are possible, a more detailed review of exposure is performed. That review is then combined with scientific

3 Averages are often calculated using detected concentrations only and do not take into account nondetected (ND) values. Although this tends to overestimate the true average values, to be more protective of public health we chose to base our health evaluations on the more conservative (higher) averages.

information from the toxicological and epidemiologic literature about the health effects from exposure to hazardous substances.

Sources for Health-Based Guidelines

By Congressional mandate, ATSDR prepares toxicological profiles for hazardous substances found at contaminated sites. These toxicological profiles were used to evaluate potential health effects from exposure to metals, pesticides, and solvents at Galena and at other sites considered in this assessment. ATSDR's toxicological profiles are available by contacting the National Technical Information Service (NTIS) at 1-800-553-6847 or on the Internet at http://www.atsdr.cdc.gov/toxpro2.html. For more information about the toxicological profiles, please call ATSDR at 1-888-42-ATSDR. EPA also develops health effects guidelines, and in some cases, ATSDR relied on EPA's guidelines to evaluate potential health effects from exposure to soil. These guidelines are found in EPA's Integrated Risk Information System a database of human health effects that could result from exposure to various substances found in the environment. IRIS is available on the Internet at http://www.epa.gov/iris. For more information about IRIS, please call EPA's IRIS hotline at 1-301-345-2870 or e-mail at Hotline.IRIS@epamail.epa.gov .

Chemicals Without Health-Based Guidelines

Essential nutrients such as calcium, iron, manganese, and zinc are important minerals that maintain basic life functions; therefore, certain doses are recommended on a daily basis (e.g. National Academy of Science 2001). Because these chemicals are necessary for life, MRLs and RfDs do not exist for them. These chemicals are found in many foods, such as milk and table salt. Exposure to these essential nutrients in the drinking water supply or in foods consumed will not result in harmful health effects unless the levels are greatly elevated above dietary requirements. For example, health problems can arise if the dietary intake of salt (sodium) is too low or too high.

Evaluation of Public Health Issues and Concerns

In this section, ATSDR evaluates environmental data to determine whether releases of contaminants to the environment pose health threats to people working or living at the Galena Airport, in the community of Old and New Town Galena, or to people who visit or make use of locations in or near the former Campion AS or the Kalakaket Creek WAS. ATSDR is not empowered to evaluate occupational exposures to contaminants.

The issues and concerns evaluated in this section were identified in several different ways. ATSDR asked individuals who are familiar with the sites what they thought were significant issues or concerns. Those interviewed included members of the Louden Tribal Council staff, officials in federal and state government, and residents of the Galena area. ATSDR reviewed available site documents to determine sources of contamination, potential pathways of contaminant migration, and potential points of human exposure to those contaminants. Finally, during the ATSDR site-visit to the Galena area, ATSDR observed sites and was made aware of situations that needed further evaluation.

Many of the important documents ATSDR reviewed and referenced in the preparation of this PHA include analytic data that record positive, quantified detections of targeted chemicals or analytes. These analytical results also typically include results that are ‘qualified’ or judged questionable for a variety of technical reasons and results that are labeled as ‘non-detects’ (ND). In the tables of analytical results presented in this PHA, ATSDR recorded the quantified detections and did not include the data that was judged questionable or the NDs (unless inclusion of qualified data or NDs was necessary for clarity). By only evaluating the positive detections, the data considered by ATSDR has a hi-bias, which is highly conservative and protective of the health of the general public and sensitive sub-populations.

In the following section the issues and community concerns are presented and using the following format: 1) each issue or concern is stated, 2) a brief summary of ATSDR’s conclusions is presented, and 3) the data and information in detail that ATSDR considers in formulating its conclusions. A summary of the two completed and five potential pathways of environmental exposure evaluated in the following sections of this PHA are given in Table 1.

Issue: Is Water From Wells at the Galena Airport, at the Galena City Wells, or From Private Wells, Safe To Drink?

The following discussion will evaluate three separate sources of drinking water used by the residents of the Galena Area. They are: 1) the Galena Airport municipal water well system, 2) the city of Galena municipal water well system, and 3) the Old Town private drinking water wells. The evaluation of the municipal systems includes a review of both the quality of the water supplied to users after it has passed through the treatment system (treated water) and the quality of the raw, untreated groundwater tapped by the municipal wells. Given below are several overall conclusions applicable to the Airport and city Municipal systems alike. Those overall conclusions are followed by a detailed review of the individual systems.

Overall Conclusions:

- ATSDR concludes that the drinking water supplied by the Galena Airport and the city of Galena municipal systems is safe to drink. The water supplied by those systems has been safe to drink in the past and will be in the future. ATSDR concludes that the drinking water supplied by private drinking water wells in the Old Town Galena area is generally safe to drink. The levels of naturally occurring iron and manganese in certain wells are above health-based comparison values or secondary drinking water standards, but are not likely to result in adverse health effects. These overall conclusions are supported by the following discussion of the three separate drinking water sources:

Discussion:

Previous Investigations

The former Galena AS, as well as the other sites reviewed in this PHA, used fuels and solvents in support of their missions and other substances such as pesticides for insect control. A variety of activities were conducted at these installations such as fueling of aircraft and vehicles, using solvents for maintenance activities, heating of buildings using petroleum fuels, and conducting fire training activities. During the operation of those installations numerous leaks and spills of fuels and, to a lesser extent, other substances, occurred.

Because concerns arose about contamination at these sites, the USAF conducted site investigations designed to identify and evaluate site contamination. As part of this investigation groundwater contaminants at the Galena Airport and Campion AS were studied. These studies culminated in the release of the Final Remediation Investigation Report (USAF 1996).

The USAF has also been conducting ongoing, biannual, groundwater-monitoring investigations since October 1998. The most recent release of those investigations reviewed by ATSDR is the Draft Environmental Monitoring Report #7 that also summarizes the findings of the previous monitoring events (USAF 2002a).

Those groundwater investigations were guided initially by information on the history of operations conducted at both the former Galena and Campion Air Stations. This information coupled with the results of other sampling of environmental media, such as surface soils, has enabled the identification of potential contaminants of concern. Sampling and analysis plans were tailored to evaluate the presence and concentrations of those contaminants.

Because the Galena Airport and city of Galena wells are considered municipal or public wells, federal and state laws require that the systems are monitored for a number of potential contaminants to ensure that safe drinking water standards are met. The Alaska Department of Environment Conservation (ADEC), Drinking Water/Wastewater Program oversees this mandated and required periodic monitoring of the treated water supplied those wells. Under the federal and state requirements, the airport system has been monitored for potential contaminants since 1986 and the city system has been tested since 1993. The monitoring records are compiled and maintained by the ADEC (2003b).

Additional sampling of the quality of Old Town Galena private drinking water wells was conducted for the Louden Village Council and the Village of Galena by USKH (1996). The Old Town Galena private drinking water wells and the two Galena Airport drinking water wells (#1 and #7) were also sampled for the EPA and reported by Weston (2002). Additionally, the USAF (1996) also sampled four Old Town water wells in 1992 and 1993.

Galena Airport Municipal System

Issue: Is Water From Wells at the Galena Airport Safe to Drink?

Conclusions — Galena Airport Municipal System

- Data on the quality of water supplied by the Galena Airport system has been monitored for potential contaminants since 1986. After reviewing the data compiled on the quality of the treated water supplied by the Galena Airport system, ATSDR concludes that during the time interval, the drinking water supplied by the Galena Airport municipal water supply system has been safe to drink.
- Although analytical data for the Galena Airport drinking water wells prior to1986 are not available, ATSDR evaluated the location of contaminant source areas, the contaminated groundwater plume locations, and the southwesterly migration of those plumes. This information strongly suggests that, in the past, the drinking water wells at the Galena Airport were not affected by groundwater contaminants at levels that would result in adverse health effects.
- Given the available information, ATSDR concludes that drinking water supplied by the Galena Airport municipal water supply system will be safe to drink in the future. Continued testing of nearby monitoring wells will detect movement of the plumes before contamination of the Airport drinking water wells now in use. Monitoring of the quality of the treated drinking water will ensure the safety of the drinking water supplied by this system in the future.

Discussion:

Treated Water Quality

ATSDR reviewed the available treated water quality data from the ADEC (2003b) records for the Galena Airport municipal water well system. The USAF (personal communication, September 2005) also collected monthly water quality samples of the water produced by the Galena Airport municipal system during 2004. ATSDR is interested in the quality of the water from those systems actually consumed by the residents. Therefore, ATSDR first looked at the data for treated water from the Airport system (see Table 2).

The ADEC records (2003b) indicate that the Galena Airport system supplied drinking water about 26 residents and 32 “non-transients” (defined as people that use the Airport facilities and water on a daily basis such as employees or students in school). From 1986 through 2003 the system has been monitored for various analytes.

Only one group of analytes, the total trihalomethanes (TTHMs), has been detected at a level exceeding the Maximum Contaminant Level (MCL) comparison value. A one-time occurrence of elevated TTHMs (124 ppb) was recorded during the April 2002 testing. TTHM levels recorded prior to and after that 2002 test have been within the EPA MCL of 100 parts per billion (ppb). That TTHM MCL was lowered by the EPA to 80 ppb on December 31, 2003.

The total trihalomethanes (see text box) found in drinking water include chlorodibromomethane, chloroform, dichlorobromomethane, and bromoform. These chemicals are known byproducts of drinking water disinfection and are most likely disinfection byproducts rather than environmental contaminants. TTHMs are not environmental contaminants.

> An important step in ensuring that the water is safe to drink is disinfection. The public water supply is treated with chlorine (a disinfectant) to kill any potential microorganisms that can cause disease. Chlorine reacts with organic material that is naturally present in the water and forms disinfection byproducts, such as TTHMs.

Although no MCLs exist for public water systems supplying 10,000 or fewer users, ATSDR used the 80-ppb MCL for TTHM for comparison purposes. The short duration (1 year or less) of the slightly elevated level of TTHMs resulted in a dose far lower than levels known to result in adverse health effects. The presence of the TTHM compounds in drinking water at these low levels does not increase the risk of cancer.

Using the available analytical data (1986–2003), ATSDR concludes that during this time interval the drinking water supplied by the Galena Airport municipal water supply system is and has been safe to drink. The 2004 analytical data for the municipal system did not detect any environmental contamination from organic compounds.

Prior to 1986, no water quality testing data appears to be available for the drinking water at the Galena Airport or the former Galena AS. That said, however, the data recorded by ADEC during the first few years of sampling for pesticides, volatile organic compounds (VOCs), and metals do not indicate contamination of the groundwater supply at the outset of monitoring.

As discussed more fully in the following two sections of this assessment, the naturally occurring "background" levels of the metals iron and manganese are elevated. High levels of those metals have been measured in the few tests of raw, untreated water collected from the airport wells. ATSDR contacted the site manager of the Galena Airport treatment plant, John Mackey, and he reported that treatment processes involve aeration and flocculation and the targeted, safe level of iron in the treated water is 0.1 parts per million (ppm) (personal communication, October 9, 2003).

The chemistry of manganese is similar to that of iron. Among other things, the presence of manganese is influenced by the presence of iron. Processes that remove iron, such as oxidation, and the processes that remove organics, such as chlorine, also reduce to a safe level the manganese in the treated water. Thus, iron and manganese levels in the water supplied by the Galena Airport municipal water are not considered to pose a health threat

The absence of detected contaminants (aside from TTHMs) in the samples of the treated water supplied by the Galena Airport system suggest that either: 1) any potential groundwater contaminants are removed by the treatment process, 2) the drinking water wells supplying the system had not been affected by contaminants for some time prior to 1986; or 3) any groundwater plumes of contaminants that have been generated at the former Galena AS have not yet reached the Galena Airport drinking water wells. To evaluate further the past and potential future safety of the drinking water supply, ATSDR reviewed data on the quality of the raw, untreated water collected from the Galena Airport. That evaluation is given in the next section of this report.

Raw Water Quality (Galena Airport)

In an effort to evaluate further the potential that contaminated groundwater could have affected the quality of drinking water previously supplied to residents and users of the system, ATSDR next examined the data available for the raw (untreated) groundwater tapped by the airport wells. ATSDR reviewed raw water data collected by the USAF (1996) during 1987 and from 1992 to 1994. That data is apparently the first such data collected. The ADEC (2003c) also has records of four raw water analyses collected during September 1987. Subsequently, Weston (2002) sampled the raw water produced by the Airport wells. The data collected by those studies are summarized in Table 3.

The most recent samples of the raw water tapped by the airport wells were collected by the USAF (2004a). That sampling program included samples collected in October and December 2003 and in February, March, and April 2004.

At present, there are two wells that can be used to supply drinking water at the Galena Airport. Those wells are known as Well #1 and Well #7 (sometimes referred to as Well #2). Those wells are screened (perforated or otherwise fitted with slotted well casing to permit groundwater to enter the well) at a depth of about 200 feet. Thus, those wells produce water from deep within the alluvial aquifer. Those wells are located in areas that, while relatively near plumes of groundwater contamination from the multiple source areas found at the Galena Airport, are producing water from deeper within the alluvial aquifer, below the depth of known contamination. Water is drawn from those wells at a rate of about 55 gallons per minute and the wells are switched off when the 100,000-gallon holding tank is full (USAF 1996).

A summary of the water wells previously used at the former Galena AS and subsequently abandoned, capped, or converted to another use is provided in the following list:

Wells Previously Used at the Galena AS

- In the past, there were a total of seven wells at Galena AS. Well #4 is capped and inactive. Wells #5 and #6 were abandoned when the buildings that housed them were demolished as part of the deactivation of Galena AS. *Those three wells were sited in locations remote from areas of known contamination and ATSDR concludes that there is no reason to assume that Wells #4 – #6 were contaminated in the past, prior to being capped or abandoned.*
- Well #3 supplies water for dust control and for fire protection and does not supply drinking water (USAF 1996).
- Well #2 was used for the production of drinking water but was replaced by Well #7 in September 1992. The 1986 to 1992 records of treated water quality at Galena AS do not indicate contamination of water supplied by this well. Well #2 is now deactivated and is only used to monitor changes in aquifer characteristics (USAF 1996). Well #2 and Well #7 are located in close proximity to each other and were drilled to about the same depth. It is reasonable to assume that the character of the groundwater measured in Wells # 2 and 7 would be essentially identical.

As part of the remedial investigation process, the USAF (1996) sampled Wells #1– #4 in 1992; Well #7 in 1993; and Wells #1, #3, and #7 in 1994. In 1992, Diesel Range Organics (DRO) were detected at 210 parts per billion (ppb) in Well #3 but not again in 1994. In an earlier round of USAF sampling in 1987, toluene was detected in all the drinking water wells at levels ranging from 2–3 ppb. Low levels of chloroform were detected in samples collected in 1987. Chloroform was again detected in the 1992 and 1994 samples obtained from Well #3. The analysis of the raw water from those wells also yielded very low and inconclusive detections of the pesticides aldrin and dieldrin in 1992, no detections in 1993, and very low levels of aldrin and dieldrin in 1994 (see Table 3).

Weston (2002) sampled the raw water from Airport Wells #1 and #7 (see Table 3). The samples were taken as close to the wellhead as possible, before any treatment; thus they should be considered representative of the water in the alluvial aquifer at that location. These values are for the raw water and do not indicate the level of metals after treatment. As previously noted, the water is treated to obtain an iron level of 0.1 ppb; with the treatment process employed, manganese levels are similarly reduced. The analyses did not indicate the presence of any pesticides, including aldrin and dieldrin. The analyses of metals did disclose that the level of iron and manganese in both airport drinking water wells were above EPA's Secondary Maximum Contaminant Level (SMCL) for those metals. Levels detected above the SMCL could affect the taste, color, or odor of the water or result in secondary health effects such as discoloration of teeth. Metals found above the SMCLs do not indicate a health hazard; iron and manganese metals are actually essential nutrients for the body.

Iron

Iron is used by the body to make hemoglobin, which transports oxygen in the blood from the lungs to other areas of the body that need oxygen It also helps the body's resistance to stress and disease. Additionally, iron prevents fatigue and promotes good skin tone, according to Austin Nutritional Research (ANR 2001). The U.S. Food and Drug Administration (FDA) established Daily Values for essential nutrients. The Daily Value for iron is 18 milligrams (mg) from all sources (food, drink, and dietary supplements). However, men and postmenopausual women are advised to try to limit their iron intake about 50% of the Daily Value. ATSDR calculated the daily intake of iron from drinking the raw (untreated) water at the maximum level detected (6,550 ppb). The maximum daily intakes are about 75 percent (%) of the Daily Value for adults and about 33% of the Daily Value for children. Even though the raw water is not consumed, drinking water with iron at those levels is not, in itself, a health threat.

Manganese

Manganese is an antioxidant that helps produce energy for the body. The average amount of manganese in a normal diet is about 1 to 5 mg a day (ATSDR 1997). Very high levels of manganese in the diet might, however, cause harmful effects. The FDA has established a Daily Value for manganese of 2 mg. ATSDR calculated the daily intake of manganese from drinking the raw water at the maximum level detected (398 ppb). The maximum manganese-level detected is less than 50% of the Daily Value for adults and 20% of the Daily Value for children. Even though the raw water is not consumed, drinking water with manganese at those levels does not pose a health threat.

Those sporadic or possible detections of environmental contaminants, such as pesticides, toluene, and DRO are below the comparison values and at levels far below those known to result in adverse health effects. The presence of those compounds in the drinking water supply does not increase the risk of adverse health effects.

As part of the Remedial Investigation, the USAF (1996) collected groundwater samples in areas thought to be unaffected by the influences of human activities at Galena AS or other non-USAF human activities. Those samples of "natural," uncontaminated groundwater are known as "background samples." The levels of naturally occurring metals and other compounds detected in the groundwater are the background or benchmark levels that can be used to measure the effects of man's activities on the groundwater or other environmental media tested. Background samples are also collected for surface water or soils. The groundwater background values developed by the USAF (1996) are also given in Table 3. The background levels of arsenic, iron, manganese, and lead are all above drinking water comparison values or EPA Action Levels.

It is possible, of course, that the background values established by the USAF are higher than the "true" background values. An incorrect determination of background can result from collection of too few background samples or from unknown influences on some sample sites that biased the background values calculated. Given, however, the geologic character of the Galena, Alaska area, high natural background values of some the metals are not unexpected.

The metals levels detected by Weston (2002) in the airport drinking water wells are below the background values recorded for those metals. Thus, even though the amount of sampling data of raw water from the airport drinking water wells is very limited, the sampling data do not suggest the presence of site-related contamination. It is clear that the levels of arsenic, iron, and manganese detected in the airport drinking water wells reflect the high natural background levels of those metals; those metals not site-related contaminants.

Unfortunately, the raw water data reviewed does not cover the time period before 1987 but significant, measurable levels of environmental contaminants were not detected in the earliest raw-water samples. These results also suggest that the airport drinking water wells probably were not affected by significant contaminants prior to 1987.

The raw water samples collected at the influent side of the airport wells by the USAF (2004) were all analyzed for numerous VOCs and none were detected. These analytical results further emphasize the current safety of that water supply.

Groundwater Monitoring Well Data (Galena Airport)

Numerous groundwater-monitoring wells have been installed by the USAF to locate and evaluated areas of groundwater contamination. Monitoring wells located in and near areas of known spills or releases of solvents or hydrocarbons (e.g. Gasoline Range Organic – GRO or DRO) have identified plumes of groundwater contamination.

The network of monitoring wells, supplemented by techniques such as the collection of soil gases, has delineated the configuration of the groundwater plumes containing GRO, DRO, trichloroethylene (TCE), benzene, and other contaminants. The location of the monitoring wells and the groundwater contaminate plumes is fully documented in the Draft Environmental Monitoring Report #7 prepared by the USAF (2002a). Because the regional groundwater flow in the alluvial aquifer underlying the Galena Airport is generally to the southwest, the movement of the contaminant plumes is also generally to the southwest.

The location and configuration of the groundwater plumes, although near the drinking water wells, do not indicate that the plumes have passed through the zone of groundwater captured by the wells when they are pumped. ATSDR concludes that, in the absence of analytical data for the airport drinking water wells #1 and #2 prior to 1986, the information on plume location and direction of migration strongly suggest that, in the past, the drinking water wells #1 and #2 (note: well # 7 did not replace well # 2 until 1992) at the Galena Airport were not affected by groundwater contaminants at levels that would result in adverse health effects. Continued testing of those monitoring wells will be able to detect movement of the plumes that could result in the contamination of the Airport drinking water wells now in use.

High levels of fuel and solvents, such as TCE, have been detected in the groundwater plume emanating from the vicinity of USAF Building 1845. For example, in the period from 1992 to 2001, TCE was detected in a monitoring well at levels ranging from 3,500 to13,000 ppb at depths less than about 60 feet. The MCL for TCE is 5 ppb. That plume is near Wells #3 and #7.

Although the airport drinking water wells produce water from much deeper in the alluvial aquifer (200 ft.), the USAF decided to upgrade the water treatment plant at the airport by adding an air stripper to ensure that, if the drinking water wells were contaminated in the future, TCE and other VOCs will be removed from the finished drinking water (USAF 1996). The treated drinking water delivered by the Galena Airport system has been tested for TCE and other VOCs since 1996 and only a very low level of toluene (estimated at 0.034 ppb) has been detected (ADEC 2003b). Based upon the available information on contaminant migration, ATSDR concludes that the drinking water supplied by the Galena Airport municipal water supply system will be safe to drink in the future. Continued monitoring of the quality of the treated drinking water will ensure the safety of the drinking water supplied by this system in the future.

City of Galena Municipal Water System

Issue: Is Water From the City of Galena Municipal Water Supply System Safe to Drink?

Conclusions – City of Galena Municipal Water System:

- The city of Galena municipal water supply system has been monitored for contaminants since 1993. After reviewing the available information, ATSDR concludes that the city of Galena water system has been safe to drink since 1993. The water supplied by the Galena municipal water well system was safe to drink in the past and will be safe to drink in the future because 1) the wells are located up-gradient from the Galena Airport facilities, 2) contaminants were not detected in the early testing of these wells, and 3) ongoing monitoring of the drinking water supplied by that system is required by state and federal standards. Monitoring of the quality of the treated drinking water will ensure the safety of the drinking water supplied by this system in the future.

Discussion:

Treated Water Quality

The Galena municipal wells are located in the new section of Galena, about 2 miles west of the Galena Airport. Thus, the city wells are upgradient (higher in the groundwater flow system) and isolated from any environmental releases of contaminants at the Galena Airport. Some residents of Old Town, who transport water to their residences, also use water from the city of Galena municipal system.

ATSDR reviewed the available data from the ADEC (2003b, d) records for the treated water quality data for the city of Galena municipal water system. As with the Galena Airport system, ATSDR is interested in the quality of the water actually consumed by the residents that drink water from those systems.

The ADEC (2003b) records indicate that the city of Galena system supplied drinking water to about 360 residents and 10 “non-transients” (i.e., persons who rely on more than one water source or only utilize the city of Galena source temporarily). The records provided by ADEC cover the monitoring of the city system since 1993. As discussed in the following section, ATSDR has also reviewed raw water data for the system collected in 1987 and 1994 (ADEC 2003c). Periodic monitoring is ongoing to assure that the treated water supplied by the system meets safe drinking water standards.

A review of the data compiled in Table 2 discloses that two analytes, copper and TTHMs (please see the discussion of the airport system for additional information of TTHMs) which exceed their corresponding comparison values.

The levels of copper reported by ADEC (2003b) are from samples drawn from water that have been allowed, as a testing procedure, to sit in a water line for at least 6 hours. The levels measured do not reflect environmental contamination, but rather the potentially corrosive effect of the water, and whether copper or lead could be leached from the water lines. When elevated levels of copper are measured, the water is treated to minimize its corrosive quality. The copper content is a reflection of testing of the water system and is not an indication that water users receive the same level of copper at their taps. Elevated copper levels trigger adjustments in the treated water quality to minimize its corrosive quality. Only very low levels of lead have been detected in the water supply. After an evaluation of the levels detected, ATSDR concludes lead is not a health concern for the system.

The TTHMs — byproducts of drinking water disinfection — were detected at levels ranging from 219 to 313 ppb (MCL 100 ppb; subsequently lowered to 80 ppb on December 31, 2003) in the city of Galena system in 2001 and 2002. ATSDR calculated the ingestion dose resulting from the highest TTHMs level (313 ppb) and calculated the ingestion dose assuming the entire excess was chloroform — a conservative assumption. The ingestion dose, especially given the 1-year duration of elevated levels, is below levels known to result in adverse health effects in adults. While the maximum level results in a slightly elevated dose for children under the age of 6 years, it is not at a level likely to result adverse health effects.

The elevated levels of TTHMs only occurred during 2001. TTHMs were measured at lower levels both before and after 2001. For adverse health effects to arise, the levels of TTHMS would have to remain at high levels for several years. Because the TTHM-level is routinely monitored, there is no reason to expect that the levels of these byproducts of disinfection in the municipal system will result in adverse health effects.

Because the levels of naturally occurring iron and manganese in the area groundwater are elevated and because those metals are not required to be reported by the Safe Drinking Water Act requirements, ATSDR contacted the operator of the city of Galena water treatment plant to ascertain what levels of iron and manganese might be removed by the treatment process. Howard Beasley, Water Treatment Plant Operator, stated that the aeration and flocculation treatment process used by the plant result in finished treated-water with a safe iron concentration ranging from 0.1 to 0.2 ppm (personal communication October 9, 2003).

As previously discussed, the removal of iron from the water, coupled with the removal of organics by the use of chlorine, also reduces the level of manganese in the treated water to a safe level. Thus, iron and manganese levels in the water supplied by the city of Galena municipal water are not considered to pose a health threat

After reviewing the available information, ATSDR concludes that the city of Galena municipal water system has been safe to drink since 1993, and because of ongoing monitoring, will be safe to drink in the future.

Raw Water Quality

ATSDR reviewed the historical records of raw water analyses from samples collected from the city of Galena wells (ADEC 2003c). Those data are given in Table 3. Similar to the raw water samples collected from the airport wells, the levels of naturally occurring iron and manganese present in the samples collected from the city of Galena wells in 1978 and 1981 are above the SMCLs. The detected levels of iron and manganese are similar to the values for those metals reported as background levels by the USAF (1996).

The raw water data do not suggest the presence of environmental contaminants at the time of sampling; rather, they imply that no contaminants affected those wells prior to 1978.

Old Town Private Drinking Water Wells

Issue: Is Water From Private Drinking Water Wells in Old Town Galena Safe to Drink?

Conclusions – Old Town Private Drinking Water Wells:

- Although little data is available on which to formulate a conclusion, after reviewing the data that are available, ATSDR concludes that the drinking water supplied by private drinking water wells in the Old Town Galena area is generally safe to drink. The levels of naturally occurring iron and manganese in certain wells are above health-based comparison values or secondary drinking water standards, but these levels are not likely to result in adverse health effects. ATSDR has recommended measures that can be taken by individual well users to reduce their exposure to those metals. We have also made recommendations for additional sampling of those private drinking water wells to validate the safety of their continued use.

- ATSDR concludes that, over a lifetime, drinking the water containing the naturally occurring arsenic from the Old Town private wells will not result in adverse health effects.

- Using the information known about the location and movement of groundwater contamination plumes at the Galena Airport, ATSDR concludes there is no evidence that contaminants released at the former Galena AS have resulted in contamination of the private wells in Old Town. Monitoring-well data collected near the contaminated sites indicate that it is unlikely that former Galena AS contaminants will affect the Old Town wells in the future. In addition, monitoring wells have been placed between the Southeast

Runway Fuel Spill — the closest contaminated site — and Old Town. These monitoring wells will serve as sentinel wells, strategically placed to provide early warning should groundwater contaminants migrate toward Old Town. For these reasons, ATSDR concludes that the drinking water supplied by the Old Town private drinking water wells will be safe to drink in the future.

Discussion:

During the site-visit ATSDR was informed that most residents of Old Town have their drinking water trucked in from the city wells in the New Town area (Carole Holley, former Environmental Director, Louden Tribe, personal communication, July 8, 2003). The USAF also recorded that most residents in the Old Town area obtain their water from the city wells. Community records indicated that at least seven private well were in use in 1992 (USAF 1996).

There has been very little testing done on the quality of the drinking water supplied by private wells in Old Town Galena. Weston (2002) conducted the most recent investigation. Samples from seven private drinking water wells were collected between March 26 and 28, 2002 (see Table 4). The sampling results disclosed elevated levels of the naturally occurring metal arsenic in three wells, elevated iron in five wells, and elevated manganese in six wells. No pesticides were detected. Two VOCs and two semi-volatile organic compounds (SVOCs) were detected at levels below comparison values.

USKH (1996) also conducted sampling of six Old Town water wells for the Louden Village Council. USKH analyzed the well water samples for VOCs only and did not detect any contaminants. The USKH analyses involved analytic detection limits higher than those used in the later Weston study. Thus, if any VOCs were present during the July 1996 time period, they are not expected to have been present in concentrations any higher than the very low levels detected by Weston.

The USAF sampled four Old Town private drinking water wells in 1992 and those same four wells again in 1993. That sampling found very low levels of the pesticides dieldrin and heptachlor epoxide (see Table 4). The testing done by the USAF did not detect any GRO or DRO.

Heptachlor epoxide was detected at the maximum concentration of 2.0 ppb in one of the four wells sampled in 1992. Sampling of that well again in 1993 did not find the pesticide. The 1993 sampling did, however, detect heptachlor epoxide (0.065 ppb) in a different well.

Because the maximum levels of the naturally occurring metals arsenic, iron, and manganese, and the pesticide heptachlor epoxide were above comparison or screening values, ATSDR evaluated those substances to determine if adverse health effects were possible from drinking water supplied by those private wells.

Arsenic

Weston (2002) detected arsenic in three of the seven wells tested (range 4.1–8.0 ppb; Wells # 02134001, 02134002, and 02134006). Because no data is available to determine how long the water in those three wells may have yielded water with elevated levels of arsenic, ATSDR first evaluated the potential health effects assuming a lifetime of exposure (Exposure Duration for adults = 30 years (noncancer),70 years (cancer); for children = 6 years). Using these conservative assumptions and the maximum detected arsenic value of 0.008 parts per million (ppm; see Table 5; Well # 02134002), the resulting exposure dose is below the levels known to result in health effects in adults and is slightly elevated for children. Still, the maximum estimated children's dose equals the level ATSDR (2000a) determined to be the no-observed-adverse-health-effects level (NOAEL). Thus, ATSDR does not expect adverse health effects in children exposed to the maximum detected level of arsenic measured in the drinking water of the Old Town wells.

Then, ATSDR assumed that over a lifetime it is more reasonable to use the average level of arsenic (0.0056 ppm) detected in the water from those Old Town wells. Using the average arsenic level, the resulting exposure dose is below the 0.0003 mg/kg/day Minimum Risk Level (MRL) for adults and the same order of magnitude for children. It must also be recognized that the limited sampling of the water quality of the Old Town wells probably does not reflect the seasonal fluctuation produced by the seasonal fluctuations of the water table and flow directions influenced by the Yukon River. These seasonal fluctuations could result in an even-lower annual average dose. Thus, ATSDR concludes that over a lifetime, drinking the water containing the naturally occurring arsenic from the Old Town private wells will not result in adverse health effects.

Iron

The level of 300-ppb iron is above EPA's SMCL. Levels detected above the SMCL could affect the taste, color, or odor of the water or result in secondary health effects, such as discoloration of teeth. Metals found above the SMCL do not indicate a health hazard.

The naturally occurring metal iron is an important mineral that maintains basic life functions and is essential nutrients for the body. The Daily Values established by the FDA for iron is 18 mg. The data gathered by Weston (2002) found elevated iron in five of the seven private wells tested (range 1540 to 23,600 ppb; 300 ppb SMCL; Wells # 02134000, 02134001, 02134003, 02134005, and 02134006).

> In most cases, water with more that 0.3 ppm (300 ppb) iron can impart an unpleasant metallic taste to the water and result in red staining of plumbing fixtures and laundry. Combined with tannin in tea, coffee, and some alcoholic beverages, it produces an unpleasant grey to black color.

ATSDR calculated the daily intake of iron using the maximum level detected (23.6 ppm; Well # 02134001). That maximum iron-level was more than two-fold (262%) of the Daily Value for adults and was about 30% above the Daily Value for children. ATSDR evaluated the potential non-carcinogenic health effects of an iron drinking-water exposure of 23.6 ppm, assuming an adult lifetime exposure. The resulting estimated exposure doses for adults and children are above the conservative health guideline (see Table 5). Although these estimated doses are above the health guideline level, they are below the levels actually associated with the onset of adverse health effects.

The water samples collected by Weston (2002) were taken, with one exception discussed in the following paragraph, as close to the well head as possible, before any treatment and thus, they should be considered representative of the water in the alluvial aquifer at that location.

The Weston (2002) report indicated that it was not possible to test one well near the well head. So instead, the well was sampled after the water passed thru a water softener.

That well tested 0.21 ppm for iron. That level, much lower than the water collected from many of the other private wells, suggests that the water softening system used in that household is efficient at removing iron from the well water. ATSDR does not have a record of which private wells use water softening device. But given the very high iron levels, it is likely that most, if not all of those wells have some form of water treatment system installed to control the taste, odor, and color.

ATSDR recommends that people who use Old Town private well water for drinking and cooking have their water tested for iron content. If a water softener or other treatment system is used, it is recommended that a sample of the water that has passed through the treatment system also be tested to determine the iron level actually consumed. This will help to determine the type and efficiency of the treatment system employed. See Appendix C for a brief summary of home water treatment options.

Manganese

Manganese is a naturally occurring metal, an important mineral that maintains basic life functions, and is an essential nutrient for the body. The Daily Value established by the FDA for manganese is 2 mg per day. Because manganese, like iron, is an essential nutrient and part of a normal diet, it is difficult to determine the exact daily human dose to either of those metals. Nevertheless, using the maximum level detected in water from the Old Town wells (3.1 ppm; Well # 02134006), ATSDR did calculate the daily intake of manganese. That maximum manganese level was more than two-fold of the Daily Value for adults and a third higher than the Daily Value for children. The data gathered by Weston (2002) found elevated manganese in six of the seven private wells tested (range 591 to 3110 ppb; 50 ppb SMCL) Manganese was detected in the private well sampled after the water had passed through the household water treatment system (Well # 02134002) at an estimated level of only 6.0 ppb; well below the SMCL.

ATSDR evaluated the potential non-carcinogenic health effects of a manganese drinking-water exposure of 3.1 ppm, assuming an adult 30-year lifetime exposure. The resulting estimated exposure dose for children is above the conservative health guideline (see Table 5). Although the estimated dose for children is above the health guideline, both the adult and children doses are several orders of magnitude below levels known to result in adverse health effects (ATSDR 2000b, EPA 1998).

However, because the level of manganese, like iron, appears high, ATSDR recommends those users of Old Town private well water for drinking and cooking have their water tested for manganese content. Also, if a water softener or other treatment system is used, it is recommended that a sample of the water that has passed through the treatment system also be tested to determine the manganese-level actually consumed.

The background levels of the metals in the area groundwater (USAF 1996) are higher than most of the levels detected in the well water samples (see Tables 5). Thus, there is no reason to conclude that the levels of the metals measured in the samples from the Old Town private drinking water wells are the result of any environmental contamination from previous uses or spills at the former Galena AS or the current Galena Airport.

During the site visit, ATSDR observed scrap metal, numerous metal drums, and abandoned or disabled vehicles and snow machines, as well as discarded lead-zinc vehicle batteries on the ground in the Old Town area. Given that the private wells are relatively shallow, it is possible that, over time, these objects and discards could become local sources of contamination for the nearby drinking water wells.

Heptachlor epoxide

Heptachlor epoxide is a breakdown byproduct (metabolite) of the pesticide chlordane and is considered a probable human carcinogen (ATSDR 1993). Sampling of four Old Town wells by the USAF (1996) in 1992, detected the pesticide heptachlor epoxide at a level of 2.0 ppb. The same four wells were sampled again in 1993 and the pesticide was detected only once (0.065 ppb) in a different well. Because the sampling does not indicate a continued exposure to heptachlor epoxide, ATSDR calculated the estimated oral exposure dose using only a 1-year exposure at the maximum detected value (see Table 5).

The source of the heptachlor epoxide, an environmental contaminant, in the Old Town wells is unknown. Moreover, that pesticide was not detected in Galena Airport wells sampled by the USAF (1996). Because heptachlor epoxide is a breakdown product of chlordane, a strong and frequently used pesticide before it was withdrawn from the market; it is likely that the presence of the contaminant in the wells was from past application of chlordane in the Old Town area.

Chlordane was used in the United States from 1948 to 1988 when the persistent pesticide was withdrawn from the market because of concerns associated with human health effects resulting from exposure to the compound. From 1983 to 1988 chlordane was authorized only for applications to control termites in the home and the soil surrounding the home’s foundation (ATSDR 1994). Because, however, the pesticide was readily available prior to 1983, many individuals had private supplies of the compound and continued to use it until their supplies were exhausted. Thus, chlordane could have been used to control insects in Old Town garden plots many years before the detection of heptachlor epoxide in the groundwater. Yet no data are available to evaluate further the possible duration of human exposure to this pesticide in 1992. The low values detected do not suggest a major contamination of the alluvial aquifer.

As previously discussed in this assessment, there is pronounced seasonal fluctuations in groundwater flow in the shallow alluvial deposits near the Yukon River. Those alluvial deposits are highly permeable and the Old Town private wells are shallow and strongly influenced by groundwater changes induced by the Yukon River. These factors coupled with the fact that the contaminant was not found in the same well in successive years strongly suggests that exposure to this contaminant was of short duration. While the estimated dose is greater than the health guideline for both adults and children, given the apparent short-duration of the exposure to the pesticide, ATSDR concludes that it is unlikely that adverse health effects would result from this exposure.

In summary, and after review of the small amount of data that is available, ATSDR concludes that, even though levels of the metals arsenic, iron, manganese, and the pesticide heptachlor epoxide have been detected at elevated levels, the water supplied by the Old Town water wells is generally safe to drink.

ATSDR recognizes that state and federal regulatory standards are applied to the treated water supplied by both the Galena Airport and City of Galena municipal systems ensuring the ongoing safety of those systems. The private wells are not periodically sampled to ensure the safety of the water supplied. Therefore, as a precautionary measure and in the absence of the use of a home water treatment system, ATSDR recommends that Old Town residents with young children should consider using water from one of the systems that are treating water for drinking and cooking purposes or should either consider the installation of a home water treatment system that would reduce the metals content of that well water.

Because there is so little data available to evaluate accurately the quality and safety of the water supplied by Old Town private drinking water wells, ATSDR recommends that those private wells be sampled for two successive years in the spring and late fall or early winter. Those samples would permit further evaluation of any potential health threat that could be posed by metals or pesticides levels of those sources of drinking water.

Past and Future Safety of the Old Town Wells

The closest sources of environmental contamination to the Old Town private wells are the Southeast Runway Fuel Spill (SERFS) and the Fire Protection Training Area (FTPA; see Figure 2A). Those sites are also of potential concern because they are located upgradient to Old Town and the migration of groundwater contaminants from those sources could potentially affect Old Town wells. The contaminants of concern at the SERFS site include GRO, DRO, VOCs, and SVOCs. The contaminants of concern at the FPTA include GRO, DRO, BTEX (benzene, toluene, ethylbenzene, and xylenes), and benzo(a)pyrene.

In addition to the FTA and the SERFS 4000 gallons of JP-4 (jet fuel; a DRO) were accidentally released from a fuel tank truck near the southeast corner of the SERFS. The contaminated surface soils were excavated and removed. The USAF (1996) reported that the spill did not contribute to the contamination at the SERFS, and no further action was taken at this site.

The USAF installed several groundwater-monitoring wells in and around each of these contamination sites. Not only have those monitoring wells have been placed to characterize the type and concentration of contaminants in the groundwater, but also to determine the geographic configuration and movement of the plumes of contaminated groundwater (USAF 2002). To help ensure the safety of Old Town private wells, monitoring wells have been placed downgradient of the groundwater plumes in the general direction of their potential migration. Those monitoring wells serve as “sentinel wells” to provide early detection of the contaminants before they reach the wells of Old Town. Those wells are as close as about 660 feet north of the perimeter road separating the airport from Old Town (USAF 2002). Contaminants have not been detected in those monitoring wells near Old Town. In fact, the groundwater plumes in both the SERFS and FPTA areas have only migrated short distances.

The limited migration toward Old Town of the former Galena AS contaminated groundwater plumes located the closest to Old Town clearly indicates that in the past contaminants from those sites have not affected the quality of the water supplied by the Old Town private wells.

Groundwater-monitoring wells have been installed that will provide early warning and permit corrective measures to be taken before groundwater contaminants affect Old Town drinking water wells. For this reason, ATSDR concludes that the drinking water supplied by the private water wells will be safe to drink in the future. Local sources of contamination within the Old Town area could, however, result in groundwater contamination and affect the local wells.

Issue: Does the Indoor Air at the Galena Aviation Vocational Technical Center (GAVTC) Pose a Health Threat?

Conclusions:

- ATSDR concludes that, since beginning operations in 2002, the indoor air of the GAVTC has not been and is not now a health threat for students and teachers using the facility. If the soil gas depressurization system now in use at GAVTC continues to minimize successfully the contamination of the GAVTC indoor air, ATSDR concludes that the indoor air of the facility will be safe in the future.

Discussion

Background:

Indoor air quality in the GAVTC has been affected by past and present uses of the building. From 1970 to 1993 the GAVTC building was used as an aircraft hangar by a local flying service. During this interval, it is likely that aircraft maintenance and related uses resulted in some releases of POL and VOC solvents vapors in the hangar. Also, petroleum products from past environmental releases from the former Galena AS POL site nearby have contaminated the groundwater beneath the building. Volatile fuel components (BTEX) of that groundwater plume were then and are now being released into the unsaturated soil overlying the plume and escaping to the atmosphere. Soil gasses also seep into the GAVTC building through joints and cracks in the building foundation and floor slab and contribute to the contamination of the indoor air quality.

In 1993, the building occupants complained of fuel odors (USAF 2003b). In response to those complaints the USAF bioenvironmental specialists conducted an investigation of the Galena Airport and nearby Old Town (USAF 1994). Because of the potentially toxic effects of benzene, the 1994 study focused heavily on that compound and found localized, elevated levels of benzene in areas in or near the Old Town community playground, the west edge of Old Town, the public softball field, and northwest of the POL tanks in Old Town.

While no conclusions were drawn as to the source(s) of those elevated benzene levels, it was noted vehicular and aircraft activity appears to be involved in each location. Localized areas of elevated benzene emissions were also found near former POL sites and areas of POL usage at the airport. It was noted at this time that the indoor air levels of benzene were also elevated in and near the civilian flying services hangars. Aircraft fueling and maintenance activities were apparently responsible for at least part of the elevated levels observed in most cases. the volatile emissions north (upgradient) of the flightline were, however, generally higher than those detected to the south, suggesting that the POL site contamination was the principal source. The 1994 study concluded that, while elevated in some locations, the BTEX levels at the Galena Airport and Old Town were within acceptable carcinogenic and non-carcinogenic levels. The report recommended increased airflow in the hangar buildings to decrease the air hazard (USAF 1994).

Still, complaints continued, and in 1995 a subsurface depressurization system was installed at the future GAVTC building to reduce the BTEX soil-gas intrusion into the building. That system was operated a few weeks during the spring from 1995 until 1997. Then in 1997 the building was vacated and the soil-gas depressurization system was partially dismantled (USAF 2003b).

The building was vacant until the city of Galena purchased the facility in 2000, and the Galena School District developed the hangar as a vocational school. In addition to retaining a portion of the former hangar as an area for teaching both aviation and hands-on aircraft maintenance and repair skills, a portion of the floor-level area was converted to classroom use, and offices for staff and faculty were added to an upper floor. Renovation of the building was completed in 2002 and the GAVTC opened in the fall of 2002.

The USAF review of remediation projects at Galena airport conducted in 2002 recommended the installation of a subsurface soil depressurization system to minimize vapor intrusion into the GAVTC building. As a result, a system, comprised of 2 blowers, 6 extraction wells, and 14 vacuum monitoring points, was installed during August 2002 (USAF 2003a, b). Since that time, the subsurface soil depressurization system has been in operation and the system appears to meet the design specifications.

The USAF (2002b) collected indoor air samples during August and September 2002. Then, during August 24–25, 2003 and four sampling events during 2004 (January 11–12, May 31–June 1, and August 22–23), additional air samples of BTEX and other volatiles were collected to measure the quality of the indoor air and the functioning and effects of the soil-gas depressurization system (USAF 2003c, 2004b, c, d). The sampling and analysis plan for this sampling program conducted during 2003 and 2004 provides that the indoor air samples are collected in the breathing zone for a 12-hour period. One sampling period is during a school day and one sampling period is on a day when school is not in session. The results of these two-day results are compared to help identify effects of any activities conducted inside GAVTC (USAF 2003b). The sampling plan also provides for the simultaneous collection of outdoor ambient air samples from the four corners of the GAVTC building and observations of meteorological conditions and airport activities occurring during the sampling period to assist in the interpretations of the analytic results obtained. Elevated levels of benzene were found in some of the samples collected and those results are summarized in Tables 6 and 7. The other BTEX gasses did not exceed comparison values (CVs).

GAVTC offers students four semesters of high school instruction and two semesters of post-secondary education (a total of six semesters or 3 years). It was originally estimated that students completing this course of instruction spend 1.5 hours per day (hr/day) for 42.5 days the first semester and then 3 hr/day for the remaining three semesters as high school students at GAVTC. Post-secondary students spend 6 hr/day for 180 days over two semesters at GAVTC. The total time spent at GAVTC is about 1426 hours (USAF 2003b).

It was originally estimated that full-time teachers at GAVTC spend a maximum of 8 hr/day for 133 days per year. It is forecast that the teaching staff will spend no more that 10-years at GAVTC (USAF 2003b). These time estimates do not reflect that some students and faculty spend a portion of their GAVTC instructional time in flight training.

The ADEC (2005) supplied additional information on the contact hours and days for students and instructors at the GAVTC during the 2004 session. Those numbers differ some for those previously reported. Reported as of April 2004 were the following:

- High school students – 174 days in class, 4 hr/day, 108 weekend hours = 804 hr/9 month school year. This represents about a maximum of a 4 percent increased exposure from the classroom contact hours originally evaluated. The total days remain approximately180 days/school year.

- Post-secondary students – 180 days in class, 5 hr/day, 108 weekend hours = 1008 hr/9 month school year. This represents about a 4 percent decrease in exposure from the classroom contact hours originally evaluated. Including the weekend hours results in the total days increase to about 185 days/school year.

- Instructors – 185 days in class, 7 hr/day, 108 weekend hours, less 20 hours flight time = 1383 hr/9 month school year. This represents about a 4 percent decrease in exposure from the classroom contact hours originally evaluated. The total days for the teacher are about 190 days/school year.

These data represent an increase in exposure time for the high school students and a very slight decrease in exposure duration for the post-secondary students. The teacher’s daily exposure duration is decreased but, apparently the classroom time is increased from 133 days/year to 190 days/year. This 57 day increase is 16 percent increase in the total classroom time/school year.

Data Evaluation:

The levels benzene and the other BTEX gasses measured in the 2002 round of sampling are generally elevated in comparison to the 2003 and 2004 sampling results. Although not conclusive, that difference suggests that the soil vapor extraction system installed August 2002 is reducing the level of those gasses seeping into the indoor air of the building.

This evaluation focuses on benzene levels as the other BTEX gasses were not detected at levels exceeding the CVs for those compounds. Comparison of the indoor air (Table 6) and ambient outdoor air (Table 7) sampling results for benzene show that outdoor air levels of benzene are generally lower than the indoor levels. The elevated indoor air levels of benzene or other gasses can, of course, be attributed to the fact that gasses that seep into enclosed air spaces are partially trapped and cannot diffuse or dilute as rapidly as those gasses in an outdoor environment. The use of volatile solvents within the GAVTC building for cleaning metal parts can be a contributing factor to the total volatile gas content of the indoor air, and could have contributed to the BTEX levels measured in 2002. The sampling and analysis plan developed for the 2003 and 2004 sampling effort was designed to eliminate or help to identify the effects of such contributions from existing indoor uses and practices (USAF 2003b).

Two CVs are useful to evaluate the levels of benzene detected in the GAVTC. Those screening tools are the Minimal Risk Level (MRL) and the Permissible Exposure Limit (PEL). Table 6 includes both measures to facilitate comparison with the values of benzene detected at GAVTC.

The Occupational Safety and Health Administration (OSHA) set PELs to protect workers against health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. The OSHA PEL for benzene is 1 part per million by volume (ppmv) or 1000 parts per billion by volume (ppbv; OSHA 1987). The PEL value is based on an 8-hour, time-weighted average.

The data recorded in Figure 6 do not exceed the benzene PEL value. Thus, using this occupational health and safety standard indicates that a daily 8-hour exposure to the levels of benzene and the other VOCs detected in GAVTC indoor air are considered safe to breathe.

MRLs are established by ATSDR and are intended to serve as conservative, health-based screening tools to help public health professionals decide if closer evaluation is warranted. The acute inhalation MRL is derived for a 24-hour per day (hr/day) exposure with a duration of 1–14 days. The intermediate inhalation MRL is derived for an exposure with a duration of 15–365 days. A chronic inhalation MRL is established for an exposure duration longer than 1 year, but, based upon current evidence, ATSDR has not yet established a chronic MRL for benzene. Exposure to a level above the MRL does not mean that adverse health effects will result.

Indoor Air in 2002 – Acute Inhalation Exposures

Some of the indoor air benzene levels detected in GAVTC during 2002–2004 were above both the acute and intermediate inhalation MRLs for benzene of 50 and 4 ppbv, respectively (see Table 6). Because the levels of benzene measure during 2002 were generally higher than levels measured subsequently, ATSDR first evaluated the acute and intermediate inhalation exposures to those 2002 levels.

Both students and teachers at GAVTC spend less time per day within the facility than the 24 hr/day exposure interval used to base the acute inhalation MRL. Using the range of GAVTC classroom contact-hours estimate (see above), a high school student is expected to spend from as little as 1.5 hr/day to as much as 4 hr/day, a post-secondary education student is apparently expected to spend 5 to 6 hr/day and a teacher is expected to spend 7 to 8 hr/day.

Thus, the maximum effective exposure period for, high school students range from 6-17 percent (%) of the 24-hour day, post-secondary students from 21-25 % of the day, and teachers from 29-33 % of the day. Applying these adjusted exposure factors to the 2002 levels of benzene result in an effective exposure of students to levels less than the acute MRL, regardless of where in GAVTC they spent their entire class-day. Similarly, the teacher would be exposed to a maximum of about 63 ppbv in the machine room and to levels less than the acute MRL in the other areas of the GAVTC. Thus, only if a teacher spent an entire 8-hour day in the machine room would the inhalation exposure exceed the acute MRL level.

If the average values of benzene detected in 2002 (see Table 6) are evaluated, the resulting estimated exposures are much lower. The average benzene exposure in 2002 would have been about 18 and 24 ppbv for the student and teacher, respectively: both levels below the acute inhalation MRL.

Indoor Air in 2002 – Intermediate Inhalation Exposures

ATSDR recognizes that students and teachers participating in the GAVTC program spend more that 14 days attending or working at GAVTC. The student who completes the program is expected to take six semesters or a total of three academic years. The teacher is targeted to spend at least 133 days per year for about 10 years. For this reason, ATSDR evaluated the maximum benzene levels detected and the maximum time spent in GAVTC by students and teachers in comparison to the intermediate inhalation exposure MRL (15–365 days). Of course, using the maximum benzene levels detected yields the most conservative of “worst-case” exposure evaluation.

Examination of the data given in Table 6 discloses that many of the benzene detections in 2002 exceed the intermediate 4 ppbv MRL value. Using the same assumption on the duration of use of the GAVTC as considered in the previous discussion, the adjusted 25% and 33% exposure levels to the maximum benzene levels in GAVTC remain elevated above the intermediate MRL level.

When evaluating exposures longer than for acute inhalation exposure intervals, it is far more realistic to use average rather than maximum detection levels. Also, because the exposure interval evaluated is longer, it is also appropriate to consider the percentage of time actually exposed during the evaluation period.

For students attending the GAVTC, the maximum expected attendance is stated to be 42.5 days during a 60-day semester, or about 71% of the days during the semester (or about 24% of the days/year, on a two-semester/year basis). For teachers the ratio ranges from about 133 to190 days/year or about 36 to 52 % of the year. Thus, the maximum exposure factor for students is 71% of the 6 hr/24 hr day or 0.71 x 0.25 = 18 % of the 24-hour days during the semester. In similar fashion, the exposure factor for teachers was originally estimated to be 36% of the 8 hr/24 hr day or 0.36 x 0.33 = 12 % of the 24-hour days during the year. The much longer 190 contact days/year results in a potential exposure of about 15 % of the 24-hour days/yr.

Applying these longer-duration exposure factors to the average indoor air benzene level detected at the GAVTC in 2002 (see Table 6) yields effective exposure levels of no more than13 ppbv/semester for students and from 9 to 11 ppbv/year for teachers. For students, on an annual basis, the effective exposure would be about 4 ppbv.

Indoor Air in 2003–2004 – Intermediate Inhalation Exposures

As previously noted, the benzene levels detected in 2002 were generally elevated with respect to those measured in 2003–2004. The observations made of metrological conditions and activities such as aircraft refueling and aircraft arrivals or departures suggest that those external factors certainly have had temporary affects upon the indoor air at GAVTC. Using the average indoor air-benzene levels detected during the 2003 and 2004 sampling program, the effective student and teacher exposure levels are below the 4-ppbv intermediate MRL.

In summary then, using the most reasonable exposure evaluation for intermediate (15 – 365 days) or longer inhalation exposure intervals yields student and teacher exposure levels slightly elevated in 2002 with regard to the intermediate inhalation MRL. Exposure levels to benzene are below the intermediate MRL in 2003–2004. The revise attendance data submitted by ADEC for 2004 would result in small changes in the exposure levels, but the exposure levels remain below the intermediate MRL using the average benzene detections for that year. For the potential health effects resulting from benzene inhalation the reader is referred to Appendix D.

Summary

For the reasons given above, ATSDR concludes that since beginning operations in 2002, the indoor air of the GAVTC has not been and is not now a health threat for students and teachers using the facility. No adverse health effects are expected to occur at the benzene levels detected in the GAVTC. If the soil gas depressurization system now in use at GAVTC continues to successfully minimize the contamination of the GAVTC indoor air, ATSDR concludes that the indoor air of the facility will be safe in the future.

Community Health Concerns

An integral part of the public health assessment process is addressing community concerns related to environmental health. ATSDR has been working with, and will continue to work with, the community to define specific health issues of concern. ATSDR has met with a variety of individuals and families, organizations, local officials, tribal officials, and state and federal officials. Meeting with a broad spectrum of community members is critical to determine the community health concerns and to assess the environmental health issues at Galena.

Member of the Galena community identified the health concerns that are evaluated in this section of the PHA.

Concern: Has the Previous Use of Pesticides Along Roadways and Other Locations Subject to Pesticide Control Resulted in Harmful Levels of Human Exposure to Those Substances?

Conclusions:

- ATSDR concludes that the pesticides detected in surface soils and sediments at the Galena Airport are not of human health concern for children or adults.
- ATSDR concludes that the levels of pesticides found at the former Campion AS are well below levels of human health concern.
- ATSDR concludes that the available data and indirect evidence indicate that the residents of Old Town Galena have not been exposed to pesticide contaminants at levels that would result in harmful health effects.

Discussion:

Galena Airport and Campion Air Station

Several pesticides have been detected in surface soils and sediments throughout the Galena Airport facility. Investigations conducted in 1992 through 1994 found very low levels of the pesticides including DDT (and breakdown products DDD and DDE — collectively referred to as DDX), aldrin, dieldrin, and very minor, possible detections of heptachlor epoxide and other pesticides (USAF 1996). The results of that sampling activity as well as the sampling collected by USKH (1996) are given in Table 8. Because heptachlor epoxide was detected in two Old Town drinking water wells (see Table 4), that pesticide was included in Table 8 to document that no positive, unqualified detections of the pesticide were found in surface soils or sediments during any of the sampling efforts. As shown in Table 8, the persistent organochlorine pesticides DDX, aldrin, and dieldrin are the most commonly detected at the Galena Airport

No records appear available to describe the quantities, dates, or specific details on specific locations of application of these pesticides, but the analytic results obtained by the USAF (1996) indicate — and ATSDR agrees — that the widespread, low-level of occurrence of those pesticides strongly suggests an area-wide application for insect and mosquito control. Generally, the widespread occurrence and the low-level detections of pesticides do not appear to indicate spills, leaks from bulk storage, or a localized accumulation (such as a rinse-out area for pesticide application equipment) of one or more of those pesticides.

Possible exceptions to that general conclusion could occur at the far northern area of the Airport property in the area occupied by the Bureau of Land Management (BLM). There, in an area apparently used as a storage area by the BLM, the USAF (1996) found DDT at 21,400 micrograms per kilogram (µg/kg) or 21.4 mg/kg (see Table 8). This DDT level is greater than ATSDR's CV for this compound.

Elsewhere at the Galena Airport, elevated levels of DDD, DDT, and dieldrin were found in surface soil samples MB-SS-06 and MB-SS-10. The highest DDD (37.8 mg/kg) and DDT (81.9 mg/kg) concentrations measured in those samples were also greater than ATSDR's CVs. The highest dieldrin detection (0.48 mg/kg), while not above the CV for that compound, was significantly greater than the other dieldrin detections. Those samples were collected for the USAF during 1994 in the developed (West Unit) northwest of Galena Water Well #3 and west of Well #7, respectively (USAF 1996). The levels of pesticides found in those two surface soil samples are much higher than the levels detected in other samples collected at that time. Perhaps these samples represent small, localized spills. Because, however, samples were collected near buildings, they could represent repeated application of those pesticides for insect control rather than spills.

ATSDR evaluated the combined level of DDX from the highest levels detected in the 1994 sample MB-SS-10 (see Table 8). The aggregate of those detections in that sample is 121.65 mg/kg DDX (West Unit, DDD at 37.8 mg/kg + DDE at 1.95 mg/kg + DDT at 81.9 mg/kg, see Table 8). That level of DDX represents a possible health threat for very small children. Still, the samples were collected in an industrial area not frequented by children and certainly not used by children for 365 days/year. Even if children did make frequent use of the area, if we assume that the surface soils are frozen or locally covered with snow for about 5 months per year, the level of exposure to even the most contaminated area is not of human health concern. The same conclusions are also true of the elevated levels of dieldrin detected by those samples. For those reasons, ATSDR concludes that the pesticides detected in surface soils and sediments at the Galena Airport are not of human health concern for children or adults.

Table 8 also records the pesticide levels detected in surface soils at the Campion Air Station by USKH (1996). The levels of pesticides found at Campion are well below levels of human health concern.

Old Town Galena

Table 8 records the results of sampling for pesticides in Old Town garden plots and at a few locations along or near the perimeter road constructed on the dike separating Old Town from the Galena Airport property (USAF 1996, USKH 1996). The garden plot analyses all failed to show the presence of pesticides. This is somewhat surprising because it is common for gardeners to use some pesticides on their gardens. But the lack of pesticide residue in these samples can be explained by the fact that most modern pesticides have very short half-lives ($t_{½}$). The significance of this fact will be discussed later in this section.

One sample, apparently collected from the top of the perimeter roadway, found 3.6µg/kg of DDD and 28µg/kg of DDT (USKH 1996). In 1993, surface soil samples were collected on the Yukon River side of the perimeter dike road at three locations incrementally spaced between the western edge of Old Town and the southwest corner of the dike road. Surface soils samples were collected in 1994 at the Pump Station Outfall near the southwest corner of the perimeter dike road and the southwest corner of the airport property (USAF 1996). The results of those three sampling efforts are given in the bottom row of Table 8. The levels of DDX compounds detected are below levels of human health concerns.

No air quality data appears available that would describe the quantity and possible pesticide content, if any, of particulate matter (dust) generated by traffic on the perimeter dike road and other unsurfaced roads in the area. ATSDR has not located any information that describes or quantifies an ongoing practice of pesticide application directly on the roadsides or on the road surface. Moreover, the limited amount of available data does not show the presence of pesticides in surface soils or the roadway itself at levels of human health concern.

One final line of evidence should be considered: the degree to which the pesticides are bonded or adhere to the surface soil particles and the t½ of the pesticides. First, the mobility of the pesticides in the environment is, in part, described by the degree to which the pesticides adhere to soil particles. Pesticides that bond tightly to the soil are not highly mobile in the environment and do not leach readily to the groundwater, but they could be transported by runoff as sediment or by windborne dust. Conversely, pesticides that do not bond tightly to soil particles do not persist as long in surface soils, and tend to migrate downward to join the groundwater. Particularly in warm climates, pesticides can volatilize to the atmosphere. This process, over time, results in the transfer of small but measurable quantities of the pesticides from temperate regions to Arctic regions (Mueller and Matz 2000; ATSDR 2002a).

DDX compounds bond tightly to surface soils, as do both aldrin and dieldrin. Thus, unless eroded by running water or wind and redeposited as sediments, the bulk of those pesticides tend to remain close to the site where they were originally applied. The amount of time the local surface soils are frozen or saturated during the spring melt effectively serve to limit the amount of time available for wind erosion or transportation of pesticide-contaminated dust.

The t½ of pesticides is another measure of the pesticides persistence in the environment. The t½ of a pesticide is a measure of the amount of time required for half of the initial amount of pesticide to break down. The rate of degradation is dependant upon a variety of factor such as climate, the amount of organic material or the abundance of microbial activity in the soils. Of the three pesticides under consideration DDT has the longest t½. In warm climates the t½ estimates range from about 5 to 15–20 years. In cold climates, however, the t½ could be over 100 years. In many environments aldrin is transformed to dieldrin fairly rapidly. The t½ for dieldrin in warm climates could be about 2.5 to 5 years and considerably longer in cold climates (ATSDR 2002a, b).

DDT was manufactured from 1939 until it was withdrawn from the U.S. market in 1972. DDT is still in use in foreign countries. Aldrin and dieldrin were used extensively from the 1950s until 1972 when they too were removed from the market (ATSDR 200a, b). Thus, the USAF and other tenants apparently used those pesticides at the Galena Airport property from about 1942 until about 1972. The levels of those pesticides measured in the surface soils and sediments of the airport represent the residual levels of those pesticides applied at various times from 62 to 32 years before present, and the contribution made by the global, atmospheric circulation and deposition of pesticides in northern latitudes.

No direct evidence supports the theory that the DDX pesticides aldrin and dieldrin have migrated to Old Town Galena. Because those pesticides are tightly bound to the surface soils of the Airport property, it is unlikely that erosion by running water or wind would result in significant migration of pesticide-contaminated sediments to Old Town. ATSDR did not see evidence of significant surface soil erosion that would result in transport of pesticide-laden sediments into the Old Town area or on to the perimeter road surface. The presence of the perimeter dike precludes the direct deposition of pesticide-contaminated, water-borne sediments in Old Town. If those pesticides had contaminated surface soils of Old Town by water or wind migration in the past, it is reasonable to expect, because of their long half-lives, that they would be present at detectable levels now. That said, however, with the exception of the one detection of DDX on the perimeter road itself (USKH 1996), the only other detections of DDX occur near the Pump Station Outfall (USAF 1996). The detections near the Pump Station could reflect USAF activities in that area.

Although little analytic data has been located with which to evaluate directly the potential level of pesticide contaminants in Old Town, ATSDR concludes that the available data and indirect evidence indicate that residents of Old Town have not been exposed to pesticide contaminants at levels that would result in harmful health effects.

Concern: Have Petroleum, Oil, and Lubricants (POLs) Released From Million Gallon Hill (MGH) Migrated to the Former Southwest Landfill Area and Are Those POLs Potentially Resulting in Human Exposures to Contaminants at a Harmful Level?

Conclusions:

- ATSDR concludes that the environmental contaminants released from the Million Gallon Hill (MGH) have not resulted in human exposures to those contaminants in the area east of the MGH. The nearby former Southwest Landfill area has not been affected by MGH contaminants. These sites are not pathways of human exposure to environmental contaminants.
- ATSDR concludes that the extent of contamination from environmental releases at the MGH is well characterized. Given the ongoing monitoring program and the effects of natural attenuation, it is unlikely that any off-site human exposure to the MGH contaminants will arise in the future.
- ATSDR concludes that opportunity is limited for human exposure to contaminants contained in or occasionally found on the surface of this former Southwest Landfill area. There is no evidence that contaminants within this landfill have migrated to the Yukon River.

Discussion

Background

During the ATSDR site-visit to the Galena Airport and the Galena, Alaska area during July 2003, members of the Louden Tribal Council's environmental office provided a brief tour of the area to the west of the Million Gallon Hill (MGH) POL area and the former Southwest Landfill area. The MGH is located on the western edge of the Galena Airport property. The former

Southwest Landfill area is located beyond the westernmost end of the main runway at the Galena Airport and west or outside of the perimeter dike roadway in that area (see Figure 1).

West of the MGH complex, a stand of dead, standing birch and perhaps black spruce was pointed out. The question was posed whether those dead trees could indicate contamination from MGH and further, was contamination from the MGH area adequately characterized? A review of portions of the old Southwest Landfill area had been conducted earlier, and it was asked if contaminants from MGH could be migrating downgradient, thru the landfill, and released to the Yukon River?

Million Gallon Hill

MGH is a bulk fuel-storage area that has been occupied by numerous petroleum storage tanks. Vegetation is sparse and consists of grasses and shrubs in the landscaped areas around the buildings and grasses, willows, and alders in the drainage ditches. To the west are stands of native birch and black spruce with a grass understory. The soils and vegetation of this area are reportedly undisturbed (USAF 2002a).

The hill itself is constructed of imported gravel and sand fill and, in the storage tank area, the fill is approximately 20 feet thick. The fill overlies the Yukon floodplain deposits and the seasonal water table elevations range from as much 30 feet to about 45 feet below the hilltop. Seasonal water table fluctuations, as great as 20 feet, have been recorded (USAF 2002a).

The MGH apparently derives its name from two aboveground storage tanks with a combined volume of about 1 million gallons. There were also two additional aboveground storage tanks also at the site, but they were removed. The site includes a pair of 1.05 million-gallon underground storage tanks that stored JP-4 aircraft fuel and diesel fuel.

Site contamination apparently resulted from leaks from the buried tanks and perhaps from small leaks and spills and other fuel handling practices at the site. An area to the east of MGH appears to have been contaminated by a water drainage pipe connected to the buried tanks. Also, in the past, sludge removed from the tanks may have discharged to the ground and allowed to weather and decompose on site. Later, it is known that sludge was placed in drums for off-site disposal (USAF 1996, 2002a).

The results of the MGH fuel contamination are localized areas of surface soil contamination and a two-lobed plume of groundwater contamination: one centered beneath the MGH and one east of the MGH. Here, as elsewhere at the Galena Airport, the regional groundwater flow direction is towards the south-southwest and towards the Yukon River during the summer through winter months. During May and June, when the Yukon River is near flood stage, the groundwater flow direction is reversed, and the flow is towards the north.

The groundwater plume migration toward the south-southwest has, at least in part, been retarded by this seasonal reversal in flow direction. The contaminants within the MGH plumes consist of GRO, DRO, BTEX, other VOCs and SVOCs, arsenic and lead. Locally, free product and residual fuel organics have been detected (USAF 2002a). Many of these contaminants tend to remain on top of the water table or high in the zone of saturation. The shallow groundwater near the top of the water table is the most affected by the seasonal recharge of groundwater, spreading toward the north from the Yukon River, during May and or June. This flow reversal of the ground water flow direction may have helped keep these MGH plumes in a state of flux.

The west lobe of the MGH groundwater plume remains largely centered on MGH itself. The external outlines of the benzene, GRO, and DRO plumes were larger when plotted in 1992 than when plotted in 2001 (USAF 2002a). This western plume is very slightly elongate to the south-southwest and extends perhaps 75–100 ft to the west of MGH.

The eastern MGH groundwater plume is located to the east of MGH near building 1488. The external outlines of the GRO and DRO plumes are smaller when they were delineated in 2001 than when measured in 1992 (USAF 2002a). At the same time the benzene plume is, in 2001, more elongated to the south-southwest than in 1992. Seasonally, the benzene plume now extends as far to the south southwest as a point slightly beyond building 1828. The benzene plume extent, as plotted on the site maps, is much larger that the GRO or DRO plumes because, in large part, the MCL for benzene is a much lower concentration in comparison to the concentrations used to plot the GRO or DRO limit, resulting in a larger mapped-area or extent. This mapped elongation of the plume is also due, in part, to the fact that to better delineate the extent of the contaminant plume additional groundwater monitoring wells were installed between 1992 and 2001, thus the elongation is not necessarily because of contaminant migration (Ann Farris, ADEC, Environmental Specialist, personal communication, June 1, 2004).

The character and extent of the MGH plumes are subject to ongoing monitoring (USAF 2002a). It has been recommended that additional monitoring wells be established, as necessary, to ensure that the extent of these plumes continues to be accurately established (USAF 2003a). Three air-injection bioventing systems are operating at MGH and the adjacent Missile Storage area for plume remediation. Also, there is strong evidence of natural attenuation or biodegradation of the BTEX in the MGH plumes. Thus, the concentration of these contaminants is decreasing over time (USAF 2002a).

After a review of the available evidence ATSDR concludes that the extent of contamination from environmental releases at the MGH is well characterized. There is no evidence of off-site migration of the MGH groundwater plumes that has resulted in human exposure. The ongoing monitoring program effectively characterizes the extent of the contaminant plume. Given the effects of natural attenuation it is unlikely that any offsite human exposure to the MGH contaminants will arise in the future.

Southwest Landfill

The former Southwest Landfill is located west of the perimeter dike roadway and near the end of the Galena Airport runway. The landfill is about 8 acres in size, consisting of vacant land not currently developed or occupied by any structures. There appears to be little or no human activity in the area. The southern part of the site has a cover of grass and willows and the northern part of the site is generally covered with grass. The site is bordered by the Yukon River on the south and on the west, woods and a small lake. The north limit of the landfill, as mapped by geophysical methods, lies approximately along a small northwest-trending gravel road (USAF 1996).

The mapped limit of the landfill does not extend as far north as the area of dead, standing birch and black spruce noted during the ATSDR site visit. The western extent of groundwater contamination from the MGH does not appear to extend as far to the west as the previously mentioned dead trees.

During the site-visit ATSDR observed several old auto chassis and portions of auto bodies in place along the banks of the Yukon River west of Old Town. This debris does not appear to be part of the former Southwest Landfill. It is possible that these heavy metallic objects were placed along the riverbank to retard bank erosion during periods of flood-flow of the river.

The Southwest Landfill or dump was apparently in use since the early 1940s. The community of Galena and the USAF reportedly jointly operated the site. Wastes including garbage, refuse, incinerator ash, wood, metal, construction debris, ethylene glycol, paint residue, oil filters, solvent-contaminated rags, batteries, and empty drums were buried in shallow trenches. Most of the waste was disposed of in the north half of the site (USAF 1996). ATSDR did not find a record of when waste or debris may have last been deposited in the landfill.

Within the northern half of the landfill, soil gas and geophysical evaluations indicate that the areas generally on the east and south of the landfill appear to mainly contain non-metallic waste comprised of trash, garbage, solvent-contaminated rags, and possibly tar residue from an asphalt plant that reportedly operated on the site. The northern and western portions of this north half of the landfill are shown by magnetic data to contain objects such as drums, drum lids, machinery, and other metallic debris (USAF 1996).

During 1995, Shannon and Wilson conducted studies of the Southwest Landfill to develop information on the soil, surface water, and groundwater of the site. That information was used to assist the State Department of Transportation and Public Facilities in the development of a closure plan for the landfill. Soil and groundwater were analyzed for 62 VOCs, as specified in the federal landfill monitoring requirements. Additionally, the samples were tested for pesticides and PCBs. Sampling was conducted in June 1995 (Shannon and Wilson 1995a) and in October (Shannon and Wilson 1995b) to account for the differing seasonal groundwater flow conditions known to exist in the Galena area.

During the June sampling episode the water table was elevated and groundwater flow direction was away from the river. The analyses of the unfiltered samples collected at that time did not detect pesticides or PCBs. VOCs were identified in some of the June soil samples, but the detections recorded were at very low levels below the method detection limits. VOCs were not detected in the groundwater or surface water samples collected in June. Metals were detected in all the June samples analyzed, many at levels above MCLs and the background concentrations of metals in the Galena area. Shannon & Wilson (1995a) theorized that the elevated metals levels in the groundwater of the Southwest Landfill may be due to the local background levels of those metals at this area or to landfill contamination.

The second set of samples, collected in October, were obtained when the water table had dropped about 4.5 to 5.5 feet (Shannon and Wilson 1995b) and the groundwater flow was in a south-southwest direction. The analytical results obtained from these filtered groundwater samples collected in October again did not show the presence of pesticides or PCBs. One monitoring well sample contained an estimated 2-ppb toluene and xylenes. Only a few metals were detected in the October samples, and the levels of those metals detected were markedly lower that the previous samples. Shannon and Wilson (1995b) noted that the October samples, collected when the water table was lower, could reflect the groundwater quality when the level of the water table is below the level of the wastes placed in the landfill. They also noted that the differences noted between the June and October samples could have been due to the very fine silt and clay included in the unfiltered June samples.

Because of the placement of monitoring wells, Shannon and Wilson (1995b) concluded that, in the 12 years since the use of the site was discontinued, there does not appear to be a consistent migration of metals beyond the boundary of the landfill. The results of these two studies were reviewed by the state and, in accordance with imposed requirements, on October 3, 1998, a final cover for the landfill was completed. On May 12, 1999 the Alaska Department of Environmental Conservation, Division of Environmental Health, Solid Waste Program (ADEC 1999) issued a Completion of Closure memo. The landfill was then subject to a 5-year monitoring requirement to ensure the effectiveness of the landfill closure.

The Shannon and Wilson investigations (1995a, b) did not disclose evidence of human exposure to contaminants.

Using currently available evidence, ATSDR concludes that contaminants from MGH have not migrated into the area of the former Southwest Landfill. Further, ATSDR concludes that there appears to be limited use of the area, and there is limited opportunity for human exposure contaminants contained in or occasionally found on the surface of this former Southwest Landfill area. There is no evidence to indicate that contaminants within this landfill have migrated to the Yukon River.

In summary, ATSDR concludes that the environmental contaminants released from the Million Gallon Hill (MGH) have not resulted in human exposures to those contaminants in the area east of the MGH. The nearby former Southwest Landfill area has not been affected by MGH contaminants. These sites are not pathways of human exposure to environmental contaminants.

Concern: Have Releases of Contaminants From the Former Galena Air Station, the Campion Air Station, or the Kalakaket Creek White Alice System Station Resulted in Contamination of the Traditional Subsistence Food-Chain Components?

Conclusions:

- After reviewing the available evidence, ATSDR concludes that the environmental contamination found at the Galena Airport, the Campion AS, and the Kalakaket Creek WAS site is not now and was not in the past a local source of food chain contamination.

- The Galena community harvests and consumes large quantities of fish annually. The available data on the contaminant levels found in Yukon River salmon were evaluated and ATSDR concludes that the Yukon River salmon harvested by the residents of the Galena area are safe to eat.

- ATSDR recognizes that only a small number of samples of burbot and northern pike were collected, which limits ATSDR's ability to evaluate fully the safety of eating burbot and northern pike. However, given that burbot and northern pike represent such a small percentage of the annual diet of the Galena residents, ATSDR concludes that burbot and northern pike are safe to eat, if consumed in small quantities during the year.

Discussion:

Background:

During the July 2003 ATSDR site-visit to Galena, the Galena Airport, and the nearby former Campion AS, members of the environmental office of the Louden Tribal Council and other community members voiced concerns about potential contamination of the traditional subsistence foods gathered in the greater Galena, interior Alaska area. These concerns focused on the potential effects of the environmental releases of contaminants on the quality of traditional foods harvested near the Galena Airport and formerly utilized Campion AS and Kalakaket Creek WAS sites. Specific concerns related to potential contamination from POLs potentially released by drums scattered in the area by 1944 and 1945 floods on the Yukon River or from leaks or spills at these three formerly utilized USAF sites.

Traditional Foods in the Galena, Alaska Diet

The value of traditional subsistence foods in the diet of Alaska residents has been documented or summarized in numerous reports (e.g., Egeland, Feyk, and Middaugh 1998). Other ongoing studies seek to

1. identify the items of traditional diet and market foods consumed;
2. determine the health risks and benefits of traditional versus market diets;
3. evaluate the differences and implications of native and science perspectives; and
4. develop a process of communication, education, training, and community outreach (e.g., http://www.atsdr.cdc.gov/alaska/ – last accessed February 25, 2004 or http://www.nativeknowledge.org – last accessed March 1, 2004).

Many recognize that the subsistence lifestyle and diet are of great importance to the cultural, socioeconomic, and overall health and well-being of the indigenous peoples and residents of the more remote Alaska areas (e.g., Egeland, Feyk, and Middaugh 1998). The rural Alaska stores and supermarkets have traditionally carried a relatively limited supply of meats, dairy products, convenience foods, fresh fruits, and vegetables. Those market items are often high in saturated fats, vegetable oils, and carbohydrates and lower in nutritional value. Traditional foods can be obtained at moderate cost when compared to the cost of market foods. In 1994, it was estimated that for Alaskan communities that depend on planes or boats to supply food items, the weekly cost for a family of four eating at home was $200 in the village of Elim (outside of Nome), $150 in Dillingham (about 400 miles southwest of Anchorage), and only about $90 in Anchorage (Alaska Cooperative Extension Service 1995).

The Community Profile Database [4] (CPD), prepared by the Alaska Department of Fish and Game (2002), includes subsistence harvest information for the Galena area. The harvest information gathered for 1985 is considered to be the most representative. The CPD is available at www.state.ak.us/local/akpages/FISH.GAME/SUBSIST/GENINFO/publctns/cpdb.htm - last accessed February 25, 2004).

4 The Community Profile Database was developed by the Division of Subsistence within the Alaska Department of Fish and Game to be a central repository of information on contemporary subsistence uses within Alaskan communities (Alaska Department of Fish and Game 2000).

The community harvests and consumes a large quantity of fish each day. According to the CPD, for each person in Galena, almost 600 pounds of fish was harvested in 1985 (the most representative year). The mean per capita use was 764 grams of fish per day (g/day; Alaska Department of Fish and Game 2000). An average 8-ounce (1/2-pound) meal is equal to 227 grams; therefore, according to this data, the community consumes about three meals a day of fish. However, because the ingestion rate is based on harvest data, it could overestimate the amount of fish actually eaten by the community.

Salmon comprises about 90% of the fish harvested and eaten by residents of Galena. Using the CPD harvest information, this equals a mean per capita use of 687 g/day by Galena residents. Because salmon is the most commonly caught and consumed fish, ATSDR evaluated the salmon sampling data gathered by the U.S. Fish and Wildlife Service (USF&WS 2004), discussed below, to determine if the salmon are safe to eat. A summary of the information provided in the CPD is given in the adjacent text box.

Resource	Percent Using Resource	Pounds per Capita / yr
All resources	100.0	787.1
Salmon	98.6	544.9
Non-salmon fish	98.6	61.5
Large Mammals	97.3	154.9
Small Mammals	63.5	15.4
Birds and Eggs	81.1	7.9
Vegetation	83.8	2.6

A report prepared by the Alaska Native Health Board (Ballew et al. 2003) found that the 33 Galena residents who participated in the survey consumed a maximum of 241 (52 median) pounds of salmon per capita per year. That study also found that participants consumed a maximum of 152 (36 median) pounds of moose muscle and fat annually. These recent consumption figures suggest lower consumption rates, particularly for salmon, than reported in the 1985 CPD data. These differences could be, in part, that one study focused on harvest rates and the other focused on consumption rates. The 2003 report prepared by the Alaska Native Health Board for Galena listed the top 50 foods, in descending order, by the total pounds of the types of foods consumed by the survey participants. Of the 50 foods listed, only five subsistence foods were on the list (the highest ranked was moose at number 10). The remaining 45 items were all market items.

Marcotte (1990) and Dames and Moore (1999) have summarized the seasonal cycle of subsistence food gathering and harvesting activities. The spring normally includes a variety of hunting and trapping activities, including harvest of muskrat, beaver, other fur bearing wildlife, and waterfowl.

Fishing through the ice occurs before spring break-up. Summer activities include the harvest of salmon and other fish using nets and fishwheels. Berries are also collected at this time. Fall is the time for hunting of moose and other big game. Some black bear and caribou are also taken in the fall, when available. Waterfowl are harvested during their southern migration through the area. Winter is devoted to trapping, small game hunting, and ice fishing. Occasionally moose and caribou are hunted in the winter as well.

About 95 % of the Galena area residents have some degree of concern about contaminants in traditional foods. However, it is reported that none of the residents have restricted their use of traditional foods (Tanana Chiefs Conference 1999).

Even though there may be contaminants present in the northern ecosystem food chain, there are many nutritional benefits associated with consumption of traditional subsistence foods. The following brief summary gives many of the nutritional benefits of eating traditional subsistence foods.

Nutritional Benefits of Eating Seafood and Other Traditional Subsistence Foods

- Traditional foods provide inexpensive and readily available nutrients (such as iron, zinc, copper), omega-3 fatty acids, antioxidants, vitamins, calories, and protein (Nobmann 1997; State of Alaska 1998). In addition, they are lower in carbohydrates and salt than store-bought foods. Traditional foods, which are low in saturated fat and high in monounsaturated fat and omega-3 fatty acids, are considered to be healthier than and nutritionally superior to “typical American foods” (State of Alaska 1998). It has been shown that people who gather and eat traditional foods have lower incidences of diabetes, cardiovascular disease, and obesity, as well as improved maternal nutrition and neonatal and infant brain development (Nobmann 1997; State of Alaska 1998).
- Economically, subsistence foods are very important to Alaskan communities because store-bought foods are expensive and many “typical American foods” are not readily available. In addition, a subsistence lifestyle provides meaningful, productive work where paying jobs are scarce (State of Alaska 1998). Not only do the resources provide nourishment, but they are also used for clothing, arts and crafts, home goods, and transportation (e.g., to feed dog teams). Additionally, the resources are important socio-culturally for trade and use in ceremonial occasions (Wolfe 1989).
- Many Alaskans worry that exposures to contaminants resulting from a subsistence lifestyle can potentially lead to cancer, worsen existing conditions such as diabetes and asthma, and increase the incidence of other health problems. To enable informed choices about foods, Alaskans have requested more information about the risk from these exposures and the nutritional benefits of traditional foods. To assist in this effort, ATSDR awarded a grant to the Alaska Native Health Board to support surveys of the dietary habits of Alaskans who regularly eat traditional foods. This grant formed the cornerstone for ATSDR’s Alaska Traditional Diet Project, which was developed to assist consumers of Alaskan traditional foods in making informed dietary decisions to prevent adverse health outcomes.
- Community members who would like additional information about the ATSDR Alaska Traditional Diet Project may call Leslie Campbell or Bill Cibulas, toll free, at 888-477-8737 or call Richard Kauffman in the ATSDR Region 10 office (Seattle) at 206-553-2632. ATSDR has published information about the project on the following Web site: http://www.atsdr.cdc.gov/alaska.

Contaminants in the food chain

Naturally occurring elements and compounds are integral constituents, in varying ratios, of the many different foods that comprise an individual’s diet. Certain elements such as arsenic and mercury have always been present in the environment, but the levels have increased since the industrial age. These naturally occurring substances enter the environment in two principal ways: 1) from point sources such as mining activity and from the erosion of geologic deposits rich in those minerals and 2) from global circulation of industrial wastes through the ocean and atmosphere and the accumulation of those substances, even in arctic regions far removed from the historic sources of industrial pollution.

Manufactured compounds such as the persistent organic pollutants (e.g., DDT and PCBs) are also found as contaminants in the food chain, even in regions where the use of those substances may have been absent (e.g., Ewald et al. 1998; Muir et al. 1995). Most manufactured contaminants decompose, degrade, or are otherwise transformed into substances that are less likely to result in adverse human health effects with the passage of time. Some manufactured contaminants are, however, very persistent or, in other words, have long half-lives (t½). The rate of decomposition of most man-made contaminants tends, among other things, to be temperature-dependent and slowed by the cold temperatures of regions such as the Arctic.

Evaluation of Available Data and Information

Limited analytic data is available that directly applies to the potential level of contaminants in the traditional subsistence foods gathered or harvested by the members of the Louden Tribe and other residents of Galena. The Galena area-specific data on environmental contaminants previously reviewed and evaluated in this assessment are useful in evaluating potential food chain contamination.

Groundwater

If the water table reaches the root zone of the soil or merges with the surface, the groundwater can produce a marshy area or a groundwater spring. If the groundwater is contaminated, potential sources of food chain contamination can result. Contaminated groundwater that migrates downgradient to the banks or bed of the Yukon River could also result in potential food chain contamination of that fisheries habitat. That said, however, the Galena Airport or the Kalakaket Creek WAS sites show no evidence of contaminated surface-spring seepage.

The regional flow of the groundwater below the Galena Airport and Old Town Galena is southwesterly towards the Yukon River, except in May and June during the period of maximum river stage at the time of spring breakup (USAF 1996). Groundwater discharge to the bed of the Yukon River undoubtedly occurs during periods of lower flow of the river. Still, there is no evidence that the plumes of groundwater contamination at the Galena Airport site has in the past or will in the future reach the Yukon River. Thus, ATSDR concludes that groundwater contamination at the Galena Airport has not resulted in food chain contamination.

Groundwater flow at the former Campion AS migrates generally westward toward a low marshy area. Groundwater or surface water contaminants, principally POLs, have migrated into this marshy area and into the small surface water drainage beyond (USAF 1996). This class of contaminants, however, degrades fairly rapidly in the surface environment and is not readily bioaccumulated (taken-up) in surface vegetation.

No data are available to evaluate whether any environmental contaminants have affected aquatic fauna or vegetation in this marshy area and the small drainage beyond; but it is possible that low levels of contaminants could be present in any berries or reeds, forbs, grasses, and aquatic fauna harvested in or near this marshy area and drainage.

The quantity of subsistence foods gathered from this area near the Campion AS is not known. However, as an example, the quantity of berries consumed annually, from all collecting locations near Galena, is reported to be a maximum of only 12 pounds (mean = 2 pounds) per year. It is unlikely that consumption of this small quantity of berries, even if affected by low-levels of contaminants, would result in adverse health effects.

Surface Soil Contamination

POLs, some solvents, pesticides, and PCBs have contaminated the surface soils at several locations at the Galena Airport and, to a lesser extent, at the Campion AS and Kalakaket WAS sites. The most widespread contaminants at the Galena Airport are low-levels of organochlorine pesticides. The localized surface soil contamination at these three sites is not widespread and occurs in areas of infrequent human use or direct contact with the soils and, therefore, there is limited opportunity for human exposure to those contaminants (USAF 1996). Food chain contamination is not likely to result from these localized sites of surface soil contamination.

Radian Corporation (1989) found localized detections of PCBs in 7 of 16 potential areas of concern at the Kalakaket WAS. The highest level detected was found in subsurface soils. Prolonged exposure to the highest levels of PCBs detected might result in adverse health effects, however long duration exposures are unlikely at this location. Also, given the localized nature of the contamination and the absence pathways of exposure, there is little indication that this PCB contamination represents a source of food chain contamination.

Some have expressed concern that pesticide-contaminated dust might be deposited on berries and other vegetation harvested in the Galena area. As noted previously, no data describes the quantity and composition of airborne particulate (dust) in the local area. ATSDR noted, however, that traffic on the roadways appears to be a major source of dust in the area. The available analytic evidence, presented in a previous section of this assessment, does not indicate the presence of pesticides at levels of health concern on the perimeter road surface. Other areas, except for the Yukon River banks, are mantled with moderately well developed vegetative groundcover and are not likely to be significant dust sources. Thus it is unlikely that dust accumulation on berries or other vegetation collected for human consumption has resulted in contamination of those food chain components. As a standard practice, it is recommended that such food items be rinsed prior to use or consumption.

Surface runoff, potentially carrying contaminants eroded from contaminated surface soil source-areas, can result in food chain contamination. However, there is no documented evidence of major surface soil erosion taking place at any of these three sites. ATSDR personnel participating in the site visit did not observe any potentially troubling area of surface soil erosion at the Galena and Campion sites; certainly not at those sites most affected by surface soil contamination. Further, the USAF (1996) has documented occasional ponding of surface runoff behind the perimeter dike at the Galena Airport, thus limiting any potentially eroded contaminants from reaching the Yukon River or Old Town.

Some Galena residents have expressed concern about potential food chain contamination resulting from leakage or spills from the numerous drums scattered downstream from Galena by the floods of 1944 and 1945. There is no accurate inventory of the total number of the drums or the number of those drums that may have been full, partially drained, or empty when swept away by the floodwaters. Potential releases of contaminants, possibly POLs and solvents, are also unquantified. Given the scattering or dispersal of those drums and the resultant dispersal of unknown quantities of the residual fluid contents of those drums, it is unknown, but unlikely, that any pervasive food chain contamination resulted from these drums.

The most persistent and the most likely class of contaminants to have adverse effects on the food chain are the organochlorine pesticides, such as DDT. As previously discussed in this assessment, DDT was widely used at the former Galena AS and apparently, to a lesser extent, at the Campion AS. ATSDR does not have information on the possible past use of pesticides at the Kalakaket Creek WAS site. The surface soil analyses completed by the USAF (1996) and USKH (1996) have been evaluated in this assessment by ATSDR. ATSDR concluded that those measured pesticides levels did not constitute a human health threat.

Thus after reviewing the available evidence, ATSDR concludes that the environmental contamination found at the Galena Airport, the Campion AS, and the Kalakaket Creek WAS site is not now and was not in the past a local source of food chain contamination.

Fish in the Yukon River

The native, resident, non-migratory fish that inhabit the nearby waters of the Yukon River and its tributaries, such as the northern pike or the burbot, are the most likely to exhibit evidence of local contamination. While there is no evidence local sources of contamination have affected the waters of the Yukon River, ATSDR examined the contaminant levels of those resident fish to determine if they are safe to eat.

Migratory fish species, on the other hand, such as the salmon that use the Yukon River and its tributaries for their migratory route and spawning grounds, can carry contaminants from exposures throughout their wide-ranging travels. In salmon, the presence of metals and persistent contaminants, such as DDT and PCBs, is largely due to pre-spawning exposure to ocean-borne contamination and should not be considered indicative of local contamination.

Fish Sampling Along the Yukon River

Because data are available on the levels of contaminants in the fish caught from the Yukon River, an evaluation of that data will give some guidance on whether it is safe to eat the fish.

During November 2002, because of the concern in the Galena community about possible contamination in the fish harvested from the nearby Yukon River, the environmental staff of the Louden Tribal Council (2004) collected six samples of resident, non-migratory burbot. Those samples were analyzed for metals, pesticides, and other potential contaminants.

In 1998, researchers with the U.S. Fish and Wildlife Service (USF&WS) (Mueller and Matz 2000) collected burbot from several widespread locations of the Yukon River drainage basin. Their report included not only the data on total DDT (DDX) and PCB concentrations gathered by the study, but also a summary of similar analytic data for burbot collected in numerous northern regions.

In the summer of 2002, the U.S. Geological Survey (USGS 2002), in conjunction with the USF&WS, began a study of the physiological and biochemical factors on fish in the Yukon River Basin. Included in that study are sampling information and analyses for numerous metals, pesticides, and PCBs in fish tissue. The USGS Biomonitoring of Environmental Status and Trends (BEST) Program is conducting that ongoing project. A target of 10 fish from each of three resident fish species (northern pike, longnosed suckers, and burbot) were collected at 10 sampling stations along the Yukon River and many of its tributaries. Data from that study have been released, and a report will be issued in the future. ATSDR acquired the analytic data and evaluated the northern pike and the burbot samples collected near Galena (Station #308) and the northern pike samples collected near Tanana (Station #307).

Until 2001, there had been limited sampling of salmon in Alaska, including a study of mercury in the Kuskokwim drainage (Zhang et al. 2001). Beginning in June 2001, the USF&WS (2001) initiated a systematic program to sample chinook and chum salmon in the Yukon River drainage basin. The study was designed to collect 10 samples of each salmon species at various downriver and upriver locations. The samples were distinguished between male and female samples because of potential sex-related differences in contaminant concentration. Upriver spawning salmon begin the spawning run with a higher fat content than lower river salmon. It is expected that, because the salmon do not feed during the spawning migration, some fat-soluble contaminants (like DDT) could be more concentrated when sampled in an upriver location (A. C. Matz. 2004, personal communication, March 9, 2004). Therefore, samples of spawning salmon collected in upriver locations can be considered to represent "worst case" samples for locations farther downriver.

The USF&WS gathered samples of salmon at fish camps at The Rapids and Beaver, Alaska. Samples were analyzed for numerous metals, pesticides, and PCBs (USF&WS 2001). Although those sampling locations are some distance from Galena, because of the migratory life history of salmon, the information is relevant to an evaluation of subsistence use of those fish.

Species Collected

The life history characteristics of the collected and analyzed fish are important to consider when evaluating the significance of the analytic data. Short summaries of the fish collected, for which analytic data on their contaminant levels are now or will in the near future be available, are presented below. This information and more can be viewed for all Alaskan wildlife at: http://www.state.ak.us/adfg/notebook — last accessed March 5, 2004.

Burbot (*Lota lota*) also known as lush, are resident, freshwater representatives of the cod family. They are a relatively long-living and slow-growing species. Burbot take 6 or 7 years to reach the preferred fishing size of about 18 inches. Young burbot feed almost exclusively on insects and other invertebrates, but by about the age of 5 they become voracious predators, feeding almost exclusively on fish — including other burbot.

Northern pike (*Esox lucius linnaeus*) are resident fish of the lakes, rivers, and sloughs of Alaska. Spawning begins shortly after the spring break-up of the ice. Young pike feed on crustaceans and insects. Quickly, however, they begin to feed on other small fish. Mature northern pike are predators feeding almost exclusively on other fish. Pike migrate locally to deeper waters during the winter but then migrate to shallow waters for spawning. After spawning they return to summer feeding areas and their movement is minimal.

Chinook salmon (*Oncorhynchus tshawytscha*) are Pacific salmon. They hatch in fresh water, spend a part of their life in the ocean, spawn in fresh water, and then die after spawning. Chinook salmon mature at different ages. Consequently fish in the spawning runs up the Yukon River vary greatly in size (4 to 50 pounds). Female salmon tend to be older and larger at maturity. The spawning run lasts approximately 60 days, during which the salmon do not feed. Thus, their condition deteriorates as they swim upriver, burning stored body mass for energy. Alaska rivers normally receive one Chinook run sometime between May and July.

Chum salmon (*Oncorhynchus keta*), or dog salmon, have the widest distribution of any Pacific salmon. Chum salmon typically spawn in small side channels and other areas of large rivers, like the Yukon River, where upwelling springs favor survival of their eggs. After hatching, the fry feed on small insects before moving into the Pacific. Chum salmon also vary greatly in size and range from 4 to 30 pounds. Spawning chum generally range from seven to 18 pounds and females tend to be smaller than males. Public Health Implications of Eating Fish: Evaluation of

> The EPA, Region 3, risk-based concentrations (RBCs) for fish are health-based comparison values that reflect concentrations much lower than those that have been observed to cause adverse health effects. Concentrations detected at or below RBCs are not considered to warrant health concern. This does not automatically mean, however, that eating fish with concentrations exceeding the RBCs are expected to produce harmful health effects. RBCs do not represent thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (such as site-specific exposure, duration, and frequency) for health effects, including the toxicology of the contaminant, other epidemiology studies, and the weight of evidence.

Potential Public Health Hazards ATSDR used the US EPA, Region 3, risk-based concentrations to evaluate the levels of contaminants and naturally occurring substance measured in the fish samples. A description of RBCs is given in the text box.

Louden Tribal Council Burbot Samples

As shown in Table 9, the concentrations of arsenic, mercury, and DDT in the burbot samples collected for the Louden Tribal Council are above EPA's risk-based concentrations (RBCs) for fish. However, because of the small number of fish analyzed, ATSDR is limited in its ability to evaluate further whether it is safe to eat the fish. Six burbot were sampled and, according to the CPD, burbot only comprise about 2% of the fish diet for the Galena community (the mean per capita use was 14 g/day). The information from the CPD used for this evaluation is almost 20 years old. The 2003 consumption data released by the Alaska Native Health Board suggest lesser quantities of many of the subsistence foods are consumed annually. Burbot may be even less frequently consumed than indicated in the CPD.

Biomonitoring of Environmental Status and Trends (BEST) Program Fish Samples

As shown in Table 10, concentrations of arsenic and DDT measured by the U.S. Geological Survey's BEST Program (USGS 2002) in northern pike and burbot tissue samples are, with few exceptions, lower than those measured in the Galena burbot collected for the Louden tribal Council (see Table 9). The DDT levels are below the RBC comparison values. Still, the levels of mercury in the fish tissue samples obtained by the BEST Program are generally higher than the mercury levels found by the Louden study (see Table 9). These differences could in part be due to sample preparation techniques, laboratory techniques, and detection limits and, in part, indicative of the natural range or variation reflected in these two small data sets.

Burbot Analyses Reported by Mueller and Matz (2000)

For the sake of comparison, the analytical data amassed by Mueller and Matz (2000) from several different sampling locations throughout the Yukon River drainage basin were reviewed by ATSDR. Whole burbot collected near Fairbanks, Alaska were found to have 0.16 mg/kg total DDT (DDX), wet weight. Liver tissue samples of Burbot collected from interior Alaska rivers were reported to have DDX values ranging from 0.013 to 0.55 mg/kg. While the whole fish analyses reported by this study are not directly comparable to the fish tissue data reported in the two preceding studies, these DDX values are in general agreement with the analytical results reported for the Louden Tribal Council and BEST Program studies.

Taken together, the data presented in the preceding studies of contaminants in burbot are not conclusive, or even indicative of a problem. But considering the relatively small contribution burbot and northern pike make to the total fish subsistence diet of the Galena residents, ATSDR has no basis on which to conclude that these fish species should be excluded from the diet.

U.S. Fish and Wildlife Service Salmon Sampling in the Yukon Drainage Basin

The USF&WS salmon sampling sites were at the upriver locations near Beaver, Alaska and fish camps at The Rapids along the Yukon River. At this time, ATSDR is not aware of any salmon samples that have been collected near Galena. Because salmon are a migratory species, those sampling locations are still indicative of the quality of the salmon that migrate through Galena on their way upriver.

The USF&WS (2004) data for chinook and chum salmon sampling are summarized Table 11. The values obtained for arsenic, PCBs, and DDX in the chinook salmon are above the EPA RBC concentration values. In chum salmon the arsenic and PCBs levels detected also above the RBCs. Because these contaminant levels are above the RBC concentration values and salmon represent a large part of the Galena diet, ATSDR further evaluated those contaminants to determine if consumption of salmon with those levels could represent a health risk.

About 90 % of the fish harvested and eaten by residents of Galena are salmon. Using the CPD (Alaska Department of Fish and Game 2000) harvest information, this equals a mean per capita use of 687 g/day of salmon by Galena residents. The more recent food consumption survey completed by the Alaska Native Health Board (Ballew et al. 2003) indicates, however, that the maximum consumption of salmon by Galena residents could be only about 300 g/day (mean per capita use is estimated at 65 g/day). Even using the highest consumption value of 687 g/day, ATSDR found that the calculated the consumption doses for salmon were below the health based no-observed-adverse-effect-level (NOAEL) for all contaminants, except the arsenic dose in chinook which was below the lowest-observed-adverse-effects-level (LOAEL). Thus, ATSDR concludes that the Yukon River salmon harvested by the residents of the Galena area are safe to eat.

Public Health Implications of Eating Fish: Summary

ATSDR realizes that a subsistence lifestyle is very important to the Galena community. Not only do subsistence foods provide nutritional and health benefits, but they also promote cultural, spiritual, medicinal, and economic wellbeing in the Alaska Native community (State of Alaska 1998). The available data indicate that it is safe to for the residents of Galena to eat the locally harvested salmon that make up the largest part of their annual fish consumption. The non-migratory, resident fish such as the burbot and the northern pike have higher levels of contaminants in their tissue and livers. The maximum levels of arsenic detected in burbot are higher than both the ATSDR (2000a) NOAEL and lowest-observed-adverse-effect-level (LOAEL) for both adults and children. The maximum levels of mercury detected in burbot are higher than the ATSDR (1999) NOAEL.

ATSDR recognizes that the number of samples of burbot and northern pike collected are small, which limits ATSDR's ability to evaluate fully the safety of eating burbot and northern pike. Given, however, that burbot and northern pike represent only about 2 percent of the annual diet of the Galena residents; ATSDR concludes that burbot and northern pike are safe to eat if consumed in small quantities during the year.

Old Town residents relying on private well water receive additional arsenic from that source. Considering the limited data available on those water wells and the uncertain, but apparently very small, quantities of burbot and northern pike consumed, an accurate evaluation of the combined arsenic dose is not possible. However, to minimize the intake of arsenic and mercury, as a precautionary measure, ATSDR recommends that pregnant women and families with small children consider limiting their intake of burbot and northern pike.

The Alaska Division of Public Health evaluated the potential risks from exposure to contaminants in the environment. After a thorough evaluation, they recommend continued unrestricted consumption of traditional subsistence foods in Alaska (State of Alaska 1998). On January 25, 2001, the EPA and the U.S. Food and Drug Administration (FDA) issued a general, national fish advisory on mercury in fish. That advisory was not based on the data on mercury levels in fish from Alaska. The FDA acknowledged that the mercury levels in Alaskan fish are far below average levels that were the basis of the national advisory (ADHHS 2001).

At present there are not any fish advisories for the state of Alaska (EPA 2003). However, if community members are concerned and wish to reduce their exposure to contaminants in fish, they can follow some of the general rules developed from the information contained in this assessment and from those given by the EPA and ATSDR in a fact sheet entitled "A Guide to Healthy Eating of the Fish You Catch" (2002). The following information gives a brief summary of those recommendations

Ways to Reduce Exposure to Contaminants in Fish

- As a general rule, avoid consumption of the fish tissue or organ meat of the larger members of any fish species harvested. Smaller fish are less likely to contain harmful levels of contaminants than larger ones.
- Eat fewer fatty fish or fish that feed on the bottoms of the slough, streams, and the Yukon River. Fatty fish are more likely to contain certain types of contaminants.
- Clean and dress the fish as soon as possible.
- Fillet the fish and throw away the fat and skin before cooking.
- Avoid or reduce the use of fish drippings from cooking in flavoring or broths. The drippings may contain higher levels of contaminants.
- Eat fewer fried or deep fried fish because frying retains in the portion that you will eat certain contaminants that might be present in the fish's fat.
- If the fish is to be smoked, skinned fillets will contain lower levels of contaminants than those that have been smoked whole or unskinned.

Concern: Is The Incidence of Cancer Elevated in The Galena Population? Are Environmental Releases From the Galena Airport Site or the Other Nearby USAF Sites Possibly Responsible for Cancer in the Community?

Conclusion

- In general terms, the incidence of cancer in the Yukon-Koyukuk census area, which includes Galena, is about 6 percent less than the state of Alaska as a whole, but within that census area the incidence of colorectal cancer is more than double the state rate. The exact causes of colorectal cancer are unknown, but the disease appears to be caused both by inherited and lifestyle factors.
- After analysis of the evaluations conducted, ATSDR concludes that the environmental releases of contaminants at the Galena Airport and at the former Campion AS and Kalakaket Creek WAS are not likely to result in cancerous health effects.

Discussion

Cancer is a popular generic term for malignant neoplasms. “Cancer” is also a generic term for neoplasia, which, from the Greek, means “new formation.” Cancers are new growths of the cells in our bodies. Cells are the basic unit of life: each of us has trillions of them. Our cells carry out all functions of life, from physical actions like walking to the beating of the heart. Malignant neoplasm is a medical term referring to the fact that the new growth has virulent or adverse properties that it can display in the body. Through expression of these properties, the growth can cause destruction of major organs, and in some cases, life-threatening disturbances in body function.

Cancer is not a single disease, but a group of more that 200 different diseases. The causes of cancer are numerous, and different types of cancer arise from different causes. Most cancers do not have known causes, but some are apparently related to chemical, environmental, genetic, immunologic, or viral factors. The chances for successful treatment also vary between cancer types, but early detection is always a positive factor. Similarly, the chances of survival vary between cancer types.

Benign tumors are not cancer. They usually can be removed and, in most cases, do not reoccur. Malignant tumors are cancers. The cancer cells can invade and damage the tissue and organs near them. Characteristic of cancer is the cell’s ability to grow rapidly and to invade other sites or organs in the body, independent of the tissue where it began.

A cancer incident case is defined as a newly diagnosed primary cancer. A primary cancer, or site, is the origin of the cancer, as opposed to a cancer that has spread from its point of origin. Individuals can have more than one primary cancer diagnosed at a time or at subsequent dates and, therefore the total number of incident cases might be greater than the number of diagnosed individuals (Alaska Cancer Registry, ACR 2002). Information on the incidence of cancer can be very useful in evaluating cancer trends within an area.

Cancer mortality data is expressed as the number of deaths attributed to cancer, if the underlying cause of death is listed as cancer in the records compiled by the Alaska Division of Public Health, Bureau of Vital Statistics (ACR 2002). Cancer can occur in people of all ages, but it is more common in people over 60 years of age. Statistically, one of every three persons will experience cancer sometime in their lives but, because of factors such as improved nutrition and health care, people are living longer. On the other hand, because people are living longer, the risk of developing cancer is increasing. A geographic area or community with an older population will always have more cancer than an area or community populated by a higher percentage of younger people. For a variety of reasons, cancer mortality information is not as sensitive a measure of public health issues in a community as cancer incidence information.

Commonly, cancer incidence and mortality data are statistically adjusted to account for the fact that the risk of developing cancer is strongly associated with advancing age. Cancer data that has been age-adjusted permits comparison between similar populations.

It is often estimated that about 70% of all cancers are caused by "environmental factors." Environmental factors are a broad range of external factors such as tobacco, alcohol, diet, lack of exercise, viruses, radiation, and individual exposures through sexual or occupational practices (ACR 1996).

For additional information about cancer and its many causes, the reader is directed to the following sources of additional information: 1) your health care provider, 2) The American Cancer Society at URL: http://www.cancer.org/docroot/home/index.asp , 3) or other Web sites such as: http://cancernet.nci.nih.gov , http://cdc.gov/cancer .

The Alaska Native Health Board and the Alaska Native Tribal Health Consortium provides useful resources and information about cancer and many other health issues on their Web site at http://www.anhb.org .

Cancer information in Alaska

The cancer incidence and mortality statistical records for the state of Alaska are compiled and maintained by the Alaska Department of Health and Social Services (ADHSS), Division of Public Health, Section of Epidemiology. The Alaska Cancer Registry (ACR) is an annual compilation of data and information gathered and made possible by a wide variety of health care facilities, physicians, medical records, and cancer registrars. The registry began compilation of records in their present form in 1996. Data is compiled by the areas delineated in the national census. Because of the size and the sparse population of vast areas of Alaska, cancer data in those relatively unpopulated areas are grouped into large geographic regions.

Since 1969 information on cancer in the Alaska Native population has been compiled and maintained by the Alaska Native Medical Center (http://anmc.org). Because of low population density throughout many areas of Alaska, those data are also grouped into large geographic areas. Confidentiality factors require that data cannot be available specifically for the Galena, Alaska area. The most relevant data available for Galena are cancer incidence rates reported in the 1998 annual Alaska Cancer Registry.

In the 1998 annual Alaska Cancer Registry report (ACR 1998) — the most recently released cancer registry report — it was reported that cancers of breast, lung and bronchus, prostrate, and colorectal accounted for 55.7% of all the newly diagnosed cancers in Alaska residents in 1998. The five most common cancers among Alaskan men consisted, in descending order, of prostrate, lung, colorectal, urinary bladder, and non-Hodgkin's lympyoma. The five most common cancers in Alaskan women, in descending order, were cancers of the breast, lung, colorectal, uterus, and non-Hodgkin's lympyoma. The mortality rate was 28% higher for males than females.

Lung cancer was among the most common cause of cancer deaths among Alaskans, accounting for about 30% of all cancer deaths and the leading cause of death for both men and women (ARC 1998). The use of tobacco can be a major causative factor in the incidence of cancer. ADHSS (2004) reports that Alaskan Natives, rural Alaskans, and economically disadvantaged Alaskans suffer more from tobacco use and its consequences than their non-native, urban, and more advantaged counterparts. Further, ADHHS (2004) reports that among adults, Alaska Native smoking prevalence is nearly double that of non-natives, and that Alaska Native youth are three to four times more likely to smoke than their non-native counterparts. Thus in any review of cancer incidence in interior Alaska, the use of tobacco among Native and rural Alaskans must be considered a prominent factor.

The Alaska Native Health Board has compiled a review of behavioral health risk factors, including the use of tobacco and includes several useful and interesting reports and other related resources on the Web site at http://www.anhb.org .

Incidence and Mortality of Cancer in the Galena, Alaska Area

Generalized information regarding the cancer incidence and mortality in Alaska is presented in this section. Because of the small population of Galena, Alaska, and because of the need for confidentiality of individual medical records, cancer statistics specific to Galena are not published. Also, the small size of the population would make those numbers unreliable and invalid for the purpose of evaluating trend or levels of cancer in the population. Therefore, the smallest grouping of cancer data for the Galena area is comprised of a compilation of the cancer records gathered from Kaltag, Galena, Ruby, Tanana, Nulato, New Allakaket, Stevens Village, Beaver, Fort Yukon, Koyukuk, Husila, and Hughes, Alaska (referred to as Region A below).

Cancer statistics are also aggregated and reported for the Yukon-Koyukuk Census Area and for the state of Alaska. The Alaska Cancer Registry, in its present form, has recorded cancer information on Alaskan Native since its inception in 1996. Cancer data, however, have been gathered from a variety of sources beginning as early as 1969 (ADHSS 1994). Thus, it is possible to differentiate between the incidence of cancer in Alaskan Natives and in the population as a whole. The following table is a compilation of data provided by ADHHS for total malignant neoplasms for the years 1981 to 2000, differentiated between Alaskan Native and the total populations:

Malignant Neoplasm Mortality in Alaska, Percent Occurrence (All Affected Sites)

	Population Group	*1981–1985*	*1986–1990*	*1991–1995*	*1996–2000*
Region A	Alaskan Native	9.1	9.6	17.2	18.3
	All	9.3	8.7	16.8	19.0
Yukon-Koyukuk	Alaskan Native	10.6	12.2	17.0	18.0
	All	9.9	12.2	18.1	19.3
Alaska	Alaskan Native	14.8	16.9	16.9	20.2
	All	18.7	21.3	22.7	24.2

A brief review of the data in the table shows markedly little difference between regions or populations. Although the differences are small, the residents of the rural areas appear to show lower cancer mortality than the Alaska population group. The slight increase in the cancer mortality that appears in recent years may be due to numerous factors including lifestyle factors and the increasing overall age of the population. If these data were age adjusted, it is possible that no trend would be apparent.

The following table shows the incidence of cancer in Alaska for 1998 as reported by the Alaska cancer registry. The table permits comparison of the incidence of cancer sorted by primary site for the total United States, the state of Alaska, and the Yukon-Koyukuk Census Area:

Cancer Incidence Data for Alaska, 1996–1998

	All cancers combined		***Lung***		***Colorectal***		***Breast***		***Prostrate***		***Non-Hodgkin's Lymphoma***	
	Rate*	# of Cases	Rate*	# of Cases	Rate*	# of Cases	Rate*	# of Cases	Rate*	# of Cases	Rate*	# of Cases
U.S.	400.5		56.1		43.9		114.3		142			
Alaska	409.7	5,242	**65.5**	780	45.1	527	118.1	864	129.0	673	17.0	238
Yukon-Koyukuk	384	60	n/c	6	**105.3**	16	n/c	7	n/c	8	n/c	<5

* The rate per 100,000 population, age-adjusted to the 1970 U.S. population.

Data given in bold print are statistically different from the United States

n/c – The rate was not calculated because the number of cases were fewer than 10.

The cancer incidence data points out that, in the Yukon-Koyukuk Census Area, only the level of colorectal cancer is elevated. The exact causes of colorectal cancer are unknown, but the disease appears to be caused both by inherited and lifestyle factors. Genetic factors could determine a person's susceptibility to the disease and lifestyle factors could determine which individuals then develop the disease. Diets high in fat and low in fruit and vegetables may increase the risk of colorectal cancer. Additionally, lifestyle factors such as the use of tobacco, lack of physical activity, and obesity may also increase the risk of colorectal cancer. None of the chemicals evaluated in this Assessment have a known or suspected link to colorectal cancer.

The average annual incidence rates (age adjusted) of cancer in Alaskan Natives for the years 1993–1997 has been reported by the Alaskan Native Health Board (ANHB 2000).

Overall, during that 5-year period from 1993–1997, the average annual age-adjusted incidence rate for all cancers combined is five percent higher among Alaskan Natives than the U.S. white population. Among Alaskan Natives the rates of lung cancer and cancers of the nasopharynx, most organs in the digestive tract, and the kidneys are significantly elevated. The ANHB (2000) data, given in the following table, describes the average annual, age-adjusted cancer incidence rate (per 100,000 population):

Average Annual, Age-Adjusted Cancer Incidence: Alaskan Native and U.S. White, 1993–1997, Males and Females Combined

	Alaskan Native Rate	***U.S. White Rate***
All sites	415.3	395.1
Oral cavity and pharynx	16.1	9.7
Digestive	133.3	69.3
Liver	6.9	2.8
Respiratory	96.6	59.6

Cancer and Environmental Releases of Contaminants in the Galena Area

This public health assessment has reviewed the potential human exposure to environmental contaminants in drinking water, in surface soils, in the air, and in the food chain. Exposure pathways were also evaluated to determine if contaminant migration might result in human exposure to contaminated surface water.

Even though carcinogenic and potentially carcinogenic substances were detected in some environmental media, ATSDR carefully evaluated the level of those substances to determine if cancerous health effects might result. After a review of the evaluations conducted, ATSDR concludes that the environmental releases of contaminants at the Galena Airport and at the former Campion AS and Kalakaket Creek WAS are not likely to result in cancerous health effects.

Child Health Considerations

ATSDR recognizes that in communities faced with contamination of their water, soil, air, or food, infants and children can be more sensitive to environmental exposure than adults. This sensitivity is a result of several factors, including 1) because they play outdoors, children are more likely to be exposed to certain media (e.g., soil); 2) children are shorter than adults, which means they can breathe dust, soil, and vapors close to the ground; and 3) children are smaller than adults, therefore childhood exposure results in higher doses of chemical exposure per body weight. To account for this greater susceptibility, ATSDR assumes a higher ingestion rate for children than for adults. Because children can sustain permanent damage if these factors lead to toxic exposure during critical growth stages, ATSDR devotes special attention to child health considerations.

As described in the Evaluation of Public Health Issues and Concerns section of this public health assessment, most of the chemicals detected at Galena and the other USAF sites evaluated are below conservative comparison values, and therefore are not at levels of health concern. The substances detected that were above those comparison values were further evaluated. ATSDR determined that no adverse health effects would occur from exposures to these substances.

In summary, after a thorough review and evaluation of the available data, ATSDR concludes that children are not being exposed to harmful levels of chemicals in the drinking water, surface soil, or indoor air at or near the Galena Airport or at the other USAF sites evaluated in this public health assessment.

The safety of the water supplied by the private wells in Old Town is not monitored, and elevated levels of naturally occurring metals have been detected in that well water. Therefore, ATSDR recommends, as a precautionary measure, that families with young children who use water from private wells have their water tested and, if necessary, consider the installation of a home water treatment system. ATSDR also recommends that Old Town residents with young children consider using water from city of Galena municipal system for drinking and cooking purposes.

Although no data are available on all of the traditional subsistence foods locally consumed, data are available on contaminant levels found in several species of fish harvested from the Yukon River. About 90 percent of the fish harvested and eaten by the Galena residents are salmon. After a thorough evaluation of the available data, ATSDR concludes that it is safe for children to eat salmon. The non-migratory, resident fish such as the burbot and the northern pike have higher levels of contaminants such as arsenic, mercury, and DDT in their tissue and livers. Because these fish comprise a very small fraction (perhaps 2 percent) of the total diet, ATSDR concludes that, while it is safe to eat burbot or northern pike, as a precautionary measure, ATSDR recommends that that the families with small children consider limiting the intake of those fish.

Conclusions

The conclusions presented below were developed by ATSDR following the review of the available data and information on the release of environmental contaminants from the Galena Airport site and the nearby former USAF Campion AS and Kalakaket Creek WAS sites. Additional information and supporting facts or conclusions are given in the section of the text devoted to the evaluation of the issues and concerns.

- ATSDR concludes that the drinking water supplied by the Galena Airport and the city of Galena municipal systems is safe to drink. The drinking water supplied by those systems has been safe to drink in the past and will be in the future.

- Although little data are available on which to formulate a conclusion, based on the available data, ATSDR concludes that the drinking water supplied by private drinking water wells in the Old Town Galena area is generally safe to drink. The levels of iron and manganese in certain wells are above health-based comparison values or secondary drinking water standards but are not likely to result in adverse health effects.

- ATSDR concludes that over a lifetime, drinking the water containing naturally occurring arsenic from the Old Town private wells will not result in adverse health effects.

- ATSDR concludes that, since beginning operations in 2002, the indoor air of the GAVTC has not been and is not now a health threat for students and teachers using the facility. No adverse health effects are expected to occur from inhalation of benzene at the levels detected in the GAVTC. If the soil gas depressurization system now in use at GAVTC continues to minimize successfully the contamination of the GAVTC indoor air, ATSDR concludes that the indoor air of the facility will be safe in the future.

- ATSDR concludes that the pesticides detected in surface soils and sediments at the Galena Airport are not of health concern for children or adults.

- ATSDR concludes that the available data and information indicate that the residents of Old Town have not been exposed to pesticide contaminants at levels that would result in harmful health effects.

- ATSDR concludes that the environmental contaminants released from the Million Gallon Hill (MGH) have not resulted in human exposures to those contaminants in the area east of the MGH. The nearby former Southwest Landfill area has not been affected by MGH contaminants. These sites are not pathways of human exposure to environmental contaminants.

- After a review of the available information, ATSDR concludes that the environmental contamination found at the Galena Airport, the Campion AS, and the Kalakaket Creek WAS site were and currently are not local sources of food chain contamination.

- About 90 percent of the fish harvested and eaten by the residents of Galena are salmon. Using the available evidence, ATSDR concludes that it is safe to eat the Yukon River salmon harvested by the residents of the Galena area.

- ATSDR recognizes that the number of samples of burbot and northern pike collected from the Yukon River are small, which limits ATSDR's ability to evaluate fully the safety of eating burbot and northern pike. Given, however, that burbot and northern pike represent only about 2 percent of the annual diet of the Galena resident, ATSDR concludes that burbot and northern pike are safe to eat if consumed in small quantities during the year.

- ATSDR concludes that the levels of environmental contaminants detected at or near the Galena Airport, Campion AS, and the Kalakaket Creek WAS would not result in harmful health effects for either adults or children who drink well water from the Airport, city of Galena, or private wells, who use the GAVTC, and who live, work, or consume traditional subsistence foods collected nearby. ATSDR has categorized this site as having no apparent public health hazard from exposure to environmental contaminants released from the Galena Airport site and the former Campion AS and Kalakaket Creek WAS sites. (The definitions of public health categories are included in the glossary in Appendix B).

Recommendations

- ATSDR recommends that users of Old Town private well water for drinking and cooking have their water tested for iron and manganese content. If a water softener or other treatment system is used, it is recommended that a sample of the water that has passed through the treatment system also be tested to determine the iron- and manganese-levels actually consumed.

- The safety of the water supplied by the private wells is not monitored. Therefore, ATSDR recommends that users of Old Town private wells with young children, if they have not done so already, consider the installation of a home water treatment system that would reduce the metals content of that well water. In the absence of the use of a home water treatment system, ATSDR recommends as a precautionary measure that Old Town residents with young children consider using water from either the Galena Airport of the city of Galena municipal systems for drinking and cooking purposes, given that state and federal regulatory standards are applied to ensure the water is safe to drink.

- Because little data is available to evaluate accurately the quality and safety of the water supplied by Old Town private drinking water wells, ATSDR recommends that those private wells be sampled for 2 successive years in the spring and late fall or early winter. Sample results would permit further evaluation of any potential health threat that could be posed by detected metals or other substances.

- As a precautionary measure, ATSDR recommends continued operation of the GAVTC subsurface depressurization system in accordance with the approved GAVTC Sampling and Analysis Plan USAF (2003b). This plan provides for sampling and operation frequencies. ATSDR will review the sampling results obtained to evaluate further the safety of the indoor air at the GAVTC.

- As a precautionary measure, ATSDR recommends rinsing subsistence food items such as gathered berries to remove any dust before use or consumption.

- As a precautionary measure, ATSDR recommends that pregnant women and families with small children consider limiting their intake of burbot and northern pike.

Public Health Action Plan

The Public Health Action Plan for Galena contains a description of actions taken and those to be taken by ATSDR, the USAF, the Louden Tribal Council, and other groups or agencies. The purpose of the Public Health Action Plan is to ensure that this PHA not only identifies public health hazards, but also provides a plan of action to mitigate and prevent harmful human health effects that may result from exposure to hazardous substances in the environment. The public health actions that are completed or ongoing are as follows:

Completed Actions:

The USAF has completed numerous environmental investigations at the former Galena AS and the former Campion AS and Kalakaket WAS site, as well as monitoring reports for various environmental media at the Galena Airport.

The USAF has completed several sampling analysis and study plans to guide ongoing study of environmental contamination at the Galena Airport.

ATSDR has conducted a site visit to the Galena and Campion sites during June 2003 and identified issues to be incorporated into a community health education plan.

The environmental office of the Louden Tribal Council has made contact with several agencies and groups to identify sources of public health information or to provide input to ongoing studies.

The environmental office of the Louden Tribal Council has obtained fish samples from areas of the Yukon River near Galena and obtained analyses of the contaminant content of the fish tissue and liver.

The U.S. Fish and Wildlife Service and the U.S. Geological Survey have collected and analyzed Yukon River fish.

ATSDR provided Primary Care Provider training at the Galena clinic. Robert Johnson, MD provided a two hour training session in Environmental Medicine for the three primary clinical staff at the clinic. This training focused on determining exposure pathways, taking an exposure history, pediatric environmental health, and substance-specific training on contaminants of concern noted in the PHA. A variety of materials including case studies, Tox Profile CDs, and Pediatric Environmental Health books (The Green Book) were provided as reference materials for the clinic resource library.

The following individuals were interviewed or participated in some way in the preparation of this public health assessment:

Dave Hertzog	611 CES/CEVR
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Steve Strausbauch	AFIOH
Dan Medina	AFIOH
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Tyg Julia Skywatcher	LTC
Ragine Attla	LTC
Elenor Yatlin	LTC
Phil Kuntz	LTC
Angela Matz	USF&WS
Angela Ross	ANHB
Howard Beasley	City of Galena
John Mackey	Galena Airport
Richard Kauffman	ATSDR

Ongoing Actions:

The USAF continues to conduct environmental monitoring activities and is developing a new Remedial Investigation Report for the Galena Airport site.

The USAF is planning to remove the facilities at the Kalakaket Creek WAS.

ATSDR continues to gather data and information on environmental contamination and on potential pathways of human exposure to contaminates at the Galena Airport and other nearby USAF sites. ATSDR also continues to gather information on food chain contamination.

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Tables

Table 1 – Summary of Pathways Evaluated in this Public Health Assessment

Pathway Name	*Exposure Pathway Elements*					*Comments*
	Potential Sources of Contamination	*Environmental Media*	*Point of Exposure*	*Route of Exposure*	*Exposed Population*	
Completed Exposure Pathways						
Indoor Air: GAVTC	BTEX soil gasses	Indoor air	Class rooms, offices and work areas at GAVTC	Inhalation	Students and teachers	Low levels of exposure to benzene
Food Chain: Traditional subsistence foods	Metals, pesticides, and PCBs in fish	Food-chain fish	Fish harvested from the Yukon River	Ingestion	Residents of the Galena area	Contaminants in fish are from multiple sources in the Yukon River drainage basin and the Pacific Ocean
Potential Exposure Pathways						
Drinking Water: Galena Airport	POL and solvent releases	Groundwater	Tap water and water transported	Ingestion	Employees, residents, and others	Very low level exposure to DRO, pesticides, and solvents
Drinking Water: City of Galena	Background metals; chlorination	Groundwater	Tap water and water transported	Ingestion	Employees, resident, & others	Low and infrequent exposures to TTHMs
Drinking Water: Old Town private wells	POL & solvent releases	Groundwater	Tap water	Ingestion	Residents	Elevated levels of metals
Pesticides in surface soils	Previous insect control measures	Surface soils, air	Surface soils at the Galena Airport, Campion AS, & Old Town	Dermal exposure	Residents, workers, and casual users	Pesticides locally present at low levels but no evidence of human exposure
Million Gallon Hill and SW Landfill	Environmental releases of POL and solid wastes from Million Gallon Hill and the SW Landfill	Groundwater & surface soils	None	Dermal exposure	Workers and casual users of landfill area	No human exposure and no evidence of contaminants reaching the Yukon River

Table 2 – Analytes Detected in the Treated Water Supplied by the Galena Airport and the City of Galena Drinking Water Systems

Analyte	*Range of Detections (ppb)*	*Frequency of Detection*	*Range of Detections (ppb)*	*Frequency of Detection*	*Comparison Values (ppb)*
	Galena Airport Wells		*City of Galena Municipal Wells*		
Arsenic	ND	0/4	ND-6.0	1/2	C-EMEG 3(C), 10(A), 10 MCL
Barium	100-450	2/2	82.0	1/1	RMEG 700(C), 2,000(A), 2,000 MCL
Cadmium	1.1	1/1	ND	ND	C-EMEG 2(C), (A), 5 MCL
Copper*	114-385	6/6	3,060-3,200	2/2	I-EMEG 300(C), 1,000(A), 1,300 SMCL
Fluorine	71.0	1/1	1,090	1/1	I-EMEG 4,000(C), 10,000(A), 4,000 MCL
Lead*	2.7-7.8	2/5	4.0-15.0	2/2	15 EPA Action Level
Nitrate	ND-2,960	8/11	ND-640	7/8	C-EMEG 1,000(C), 4,000(A), 10,000 MCL
TTHMs	ND-124	6/9	0.97-313	7/7	80 MCL(1)
Ethylbenzene	ND	0/9	ND-0.23	2/8	RMEG 1,000(C), 4,000(A), 700 MCL
Toluene	0.34	1/9	0.21-0.66	6/8	I-EMEG 200(C), 700(A), 1,000 MCL
Xylenes	ND	0/9	0.24-1.08	3/8	I-EMEG 2,000(C), 7,000(A), 10,000 MCL

Data derived from: ADEC (2003b)

ND - Not detected

* - 90th percentile values. Water samples are drawn after the water has been allowed to sit in a water line for at least 6 hours.

(1) The TTHM MCL changed to 80 ppb on 12/31/03.

C-EMEG - Chronic Environmental Media Evaluation Guide

I-EMEG - Intermediate Environmental Media Evaluation Guide

RMEG - Reference Dose Media Evaluation Guide

MCL - Maximum Contaminant Level (EPA)

SMCL - Secondary Maximum Contaminant Level (EPA)

ppb - parts per billion

Table 3 – Analytes Detected in the Raw Water of the Galena Airport and the City of Galena Drinking Water Wells

				Detection		
	Galena Airport Wells		***City of Galena Municipal Wells***			
Arsenic	ND	ND	8	8	27	C-EMEG 3(C), 10(A), 10 MCL
Copper	35	35	ND	ND	19	I-EMEG 300(C), 1,000 (A), 1,300 SMCL
Iron	5,720 - 6,550	4,050	7,000 - 38,500	19,600	30,700	300 SMCL
Manganese	364 - 398	392	1,400 – 2,800	2,100	45,400	RMEG 500(C), 2,000(A), 50 SMCL
Lead	ND	ND	ND	ND	16	15 EPA AL
Zinc	65 - 100	69	ND	ND	34	C-EMEG 3,000(C), 10,000(A), 5,000 SMCL
GRO	ND	ND	NT	NT	NA	NA
DRO(3)	210	210	NT	NT	NA	NA
Aldrin(3)	0.00689	0.00689	NT	NT	NA	0.3(C) 1(A) – C EMEG
Dieldrin(3)	0.0084	0.0084	NT	NT	NA	0.5(C) 2(A) – C EMEG
Phenol(1)	0.34 est.	0.34 est.	NT	NT	NA	4,000 LTHA
Chloroform(3)	1.2 - 26	13.6	NT	NT	NA	80 MCL
Toluene(3)	2-3	2.5	NT	NT	NA	1,000 MCL

Data derived from: (1) Weston (2002), (2) ADEC (2003c, d), and (3) USAF (1996).

ND – Not detected, NT – Not tested, NA- Not Applicable

C-EMEG - Chronic Environmental Media Evaluation Guide

I-EMEG - Intermediate Environmental Media Evaluation Guide

RMEG - Reference Dose Media Evaluation Guide

MCL - Maximum Contaminant Level (EPA)

SMCL - Secondary Maximum Contaminant Level (EPA)

ppb - parts per billion

Table 4 – Analytes Detected in Old Town Private Drinking Water Wells

	Analyte	Range of Detections(1) (ppb)	Average Detection (ppb)	Frequency of Detection	Groundwater Background Value(2 (ppb)	Frequency Above Background	Frequency Above Standard	Comparison Value (ppb)
Metals	Arsenic	4.1 – 8.0	5.6	3/7	27	0	3(C), 0(A)	C-EMEG 3(C)-10(A); 10 MCL*
	Copper	5.0 - 21.8	13.6	2/7	19	1	0	1,000 MCLG
	Iron	79.4 – 23,600	9,211	7/7	30,700	0	5	300 SMCL
	Manganese	6.0 – 3,100	142	7/7	45,400	0	6(C), 1(A)	RMEG 500(C)-2,000(A), 50 SMCL
	Lead	0.84 – 1.4	1.3	3/7	16	0	0	15 AL
	Zinc	4.3 – 131	30.5	5/7	34	1	0	C-EMEG 3000(C)-10,000(A), 5,000 SMCL
Pesticides	Aldrin(1,2)	ND	ND	0/15	NA	NA	0	C-EMEG 0.3(C)-1.0(A)
	Dieldrin(1,2)	0.011	0.011	1/15	NA	NA	0	C-EMEG 0.5(C)-2.0(A)
	Heptachlor epoxide(2)	0.0065 -2.0	1.0	2/15	NA	NA	1(C, A)	RMEG 0.1(C)-0.5(A), 0.2 MCL, 0.004 CREG
VOC	1,1,1-TCA	0.81 – 2.2	1.5	2/7	NA	NA	0	200 LTHA & MCL
	1,1-DCA	0.81	0.81	1/7	NA	NA	0	RMEG 2,000(C)-7,000(A), 5 MCL
	Toluene	0.2 – 0.48 est.	0.37 est.	4/7	NA	NA	0	I-EMEG 200(C)-700(A), 1,000 MCL
SVOC	1-phenyl-ethone	0.5 – 1.0	1.0	3/7	NA	NA	NA	NA
	Phenol	0.63 – 2.7	1.4	4/7	NA	NA	0	3,000(C)-10,000(A) RMEG; 4,000 LTHA

Data derived from: (1) Weston (2002) and (2) USAF (1996).

ND - Not detected, NA - Not applicable, © - Value for children, (A) - Value for adults, ppb - parts per billion

- A 10-ppb MCL will become effective on 01/23/06.

VOC - Volatile organic compound, SVOC - Semi-volatile organic compound, C-EMEG - Chronic Environmental Media Evaluation Guide, I-EMEG - Intermediate Environmental Media Evaluation Guide, RMEG - Reference Dose Media Evaluation Guide, MCL - Maximum Contaminant Level (EPA), SMCL - Secondary Maximum Contaminant Level (EPA), LTHA – Life-time Health Advisory (EPA).

Table 5 – Estimated Exposure Doses for Old Town Galena Private Drinking Water Wells and City of Galena Wells

Analyte / Location	*Maximum Detected Concentration (ppm)*	*Estimated Exposure Dose [1] (mg/kg/day)*		*Oral Ingestion Health Guideline (mg/kg/day)*	*Basis for Health Guideline*	*Groundwater Background Values[3] (ppm)*
		Adult	*Child*			
Arsenic – Old Town	0.008	0.00023	**0.00080**[2]	0.0003	Chronic MRL, RfD	0.027
Iron – Old Town	23.6	**0.67**	**2.36**	0.3	Chronic RfD	30.7
Manganese – Old Town	3.1	0.089	**0.31**	0.14	Chronic RfD	45.4
Heptachlor epoxide – Old Town	0.002	**0.000057**	**0.0002**	0.000013	Chronic RfD	NA
Chloroform – City Wells (TTHMs)	0.31	0.0089	**0.031**	0.01	Chronic MRL	NA

(1) The estimated exposure doses are based upon exposure durations of 70-years for adults and 6-years for children. The data support only 1-year of exposure duration for heptachlor epoxide and chloroform.

(2) The doses in excess of the Oral Ingestion Health Guideline are given in bold. Exposure doses greater than a health guideline do not necessarily imply that adverse health effects will occur. Health guideline values are set conservatively and are lower than levels know to result in adverse health effects. These chemicals are evaluated further.

(3) USAF (1996).

MRL - Minimal Risk Level (ATSDR)

RfD - Reference Dose (EPA)

ppm - parts per million

Table 6 – GAVTC Indoor Air Samples (ppbv)(1)

Compound - Range of Detection / Location	*Aug. 2002*	*Sept. 2002*	*Aug. 2003*	*Jan. 2004*	*May/Jun 2004*	*Aug 2004*	*Ave 2002*	*Ave. 2003*	*Ave. 2004*	*MRL[(2)] (ppbv)*	*PEL[(3)] (ppbv)*
Benzene – Range	***4.5-110***	***33-190***	***1.6-7.5***	***1-5***	***1.9-20***	***0.007-79***	***-***	***-***	***-***	***50 - acute 4 - intermediate***	***1,000***
Benzene - Average	***31.6***	***107.4***	***5.3***	***2.8***	***10.2***	***27.1***	***73.7***	***5.3***	***13.4***		
Flight Simulator	-	-	3.4-6.4	1.9-4.2	2.6-20	12-65	-	4.9	17.6		
Large Classroom	6.1	74	3.3-6.2	1.6-4.2	18-12	14-51	40.1	4.8	16.8		
Machine Room	5.8	190	5-6.7	1.6-4.6	8.5-13	12-16	97.9	5.9	9.3		
Center Hangar	110	33-120	-	-	-	-	87.7	-	-		
N. Pt. Hangar	-	-	4.3-6.1	1.7-4.3	1.9-19	0.007-0.008	-	5.2	4.5		
S. Pt. Hangar	-	-	4.7-7.5	1.6-5	2.2-15	34-41	-	6.1	16.5		
N. Pt. Shop	-	-	5-6.9	1-1.9	7-8.7	0.01-62	-	6.0	13.4		
S. Pt. Shop	-	-	4.7-6.8	1.6-4.4	3.3-13	2-79	-	6.1	17.2		
Small Classroom	4.5	120	1.6-6.1	2.3-2.5	2.5-16	8.6-37	62.3	3.9	11.5		

(1) Data from USAF (2002b, 2003c, 2004b, c, d).

(2) MRL – Minimal Risk Level: Acute exposures <14 days, Intermediate exposures >14 days and <1 year.

(3) PEL – Permissible Exposure Limit, 8-hour time weighted average (usually expressed as ppm)

ppbv – parts per billion by volume.

Table 7 – GAVTC Ambient Outdoor Air (ppbv)

Compound / Location	*August 2003*	*January 2004*	*May/June 2004*	*August 2004*	*Average 2003*	*Average 2004(2)*
Benzene – Range	***0.02 F-2.4***	***1.1-4.7***	***ND-3.0***	***4.0-4.4***	***1.2F***	***2.4 J***
NE Corner of GAVTC	1.0-2.4	1.2J-4.4	ND-1.4	NS	1.7	2.3J
NW Corner of GAVTC	0.02 F-1.7	3.3 J-4.7	3.0-0.032F	NS	0.86F	2.7F, J
SE Corner of GAVTC	0.02 F-2.1	1.1-4.6 J	0.038F- 0.23	4.0-4.4	0.86F	2.4F, J
SW Corner of GAVTC	0.02 F-2.1	2-4.5	1.1-1.3	NS	0.86F	2.2

Data from USAF (2003c, 2004b, c, d)

The average for 2004 is only comparable with previous years for the site sampled (SE Corner).

ppbv – parts per billion by volume.

ND – Not Detected.

NS – Not Sampled.

F – This data qualifier indicates that a compound was positively identified but the associated numerical value given is below the analytical reporting limit. Ranges or averages incorporating data with this qualifier carry the same qualifier.

J – This data qualifier is for estimated results. Ranges or averages incorporating data with this qualifier carry the same qualifier.

Table 8 – Range and Frequency of Pesticides Detected in Surface Soils and Sediments: Galena Airport, Campion Air Station, and Old Town Locations[1]

Location	***Analytes***											
	4,4 DDD		**4,4 DDE**		**4,4 DDT**		**Aldrin**		**Dieldrin**		**Heptachlor epoxide**	
	Range µg/kg	Freq.	Range µg/kg	Freq.	Range µg/kg	Freq.	Range µg/kg	Freq.	Range µg/kg	Freq.	Range µg/kg	Freq.
Ambient location	3.0 - 46	4/7	4.5 - 40	4/7	2.5 - 64	4/7	ND	0/7	ND	0/7	ND	0/7
Fire Protection Training Site	2.4 - 180	12/12	0.9 - 110	10/12	1.9 - 400	11/12	33	1/12	0.96	1/12	ND	0/11
West Unit	14 - 1,000	14/17	4.7 - 500	16/17	18 - 1,300	15/17	ND	0/17	ND	0/17	ND	0/17
West Unit[2]	23.2 - 37,800	20/20	5.1 - 1,950	20/20	33.4 - 81,900	20/20	21.2 - 62	3/20	7.3 - 490	14/20	ND	0/20
Building #1872[3]	ND	0/2	196	1/2	17.7	1/2	ND	0/2	ND	0/2	ND	0/2
BLM Housing Area[3]	355	1/4	178 - 1,760	4/4	155 - 21,400	4/4	ND	0/4	ND	0/4	ND	0/4
Galena POL Tank Farm[2]	245 - 791	3/3	178 - 655	3/3	127 - 809	3/3	ND	0/3	ND	0/3	ND	0/3
Pump Station Outfall[2]	ND	0/2	0.9 - 1.75	2/2	18.3 - 75.7	2/2	ND	0/2	2.87	1/2	ND	0/2
Campion AS[4]	250	1/4	ND	0/4	12	1/4	ND	0/4	-		-	
Garden Plots, Old Town[4]	ND	0/5	ND	0/5	ND	0/5	ND	0/5	-		-	
Airport Perimeter Road[5]	3.6[4] - 220[2, 3]	2/5	0.9 - 21[2, 3]	3/5	18.3 – 75.7[2,3,4]	3/5	ND[2, 3]	0/3	ND[2, 3]	0/4	ND[2, 3]	0/3

(1) Reported results are from soil samples collected in 1992 unless otherwise noted by additional footnotes (USAF 1996). Only positive detections are included in this table. (2) Reported results are from soil samples collected in 1994 (USAF 1996). (3) Reported results are from soil samples collected from 0-3.0 ft depth in 1993 (USAF 1996). (4) Reported results are from soil samples collected from an unspecified interval (USKH 1996). (5)Reported results are from both USAF 1993 and 1994 samples (USAF 1996) and samples collected by USKH (1996). The USAF results reported are from soil samples collected south of the perimeter road dike and west of Old Town.

Note: Values given in **bold** are above US EPA Region III Risk-based Concentration (RBCs) for industrial areas except for the BLM Housing Area where a residential RBC was used; – mg/kg – micrograms/kilogram; – ND – Not detected.

Table 9 – Analytes Detected in Burbot Collected for the Louden Tribal Council in the Yukon River near Galena, Alaska.

Sample Number	*Sample Weight (lbs)*	*Sample Type*	*Arsenic mg/kg*	*Mercury-metallic mg/kg*	*DDT mg/kg*	*PCBs[(1)] pg/g*
2482000	12.8	Tissue	17.9	0.11	ND	0.0
		Liver	2.4	0.16	0.25	4.5
2484001	9.0	Tissue	0.4	0.22	ND	0.0
		Liver	0.3	0.12	0.38	4.4
2484002	8.8	Tissue	0.6	0.20	ND	0.0
		Liver	0.8	0.43	ND	2.4
2484003	2.2	Tissue	ND	0.11	ND	0.0
		Liver	0.2	0.09	ND	0.7
2484004	4.4	Tissue	2.7	0.19	ND	0.0
		Liver	0.4	0.15	ND	0.9
2484005	2.0	Tissue	ND	0.06	ND	0.1
		Liver	2.0	0.04	ND	1.0
RBCs (mg/kg)			0.0021	0.14 methyl mercury	0.0093	0.0016

(1) Total Toxicity Equivalencies (TEQ)

(2) ND – Not detected

RBCs – Risk-based concentration values, EPA Region 3

Table 10 – Selected Analytes Detected in Fish Tissue Samples Collected by the BEST Program[1].

Station #/ Species	*Sex [2]*	*Arsenic (As) mg/kg*	*Mercury-metallic (Hg) mg/kg*	*DDT mg/kg*	*Total PCBs mg/kg*
308/ northern pike	M	0.07	0.33	0.00070	0.014
308/ northern pike	F	0.06	0.34	0.00060	0.021
308/ burbot	M	0.05	0.10	0.00025	0.024
308/ burbot	F	0.06	0.10	0.00048	0.029
307/ northern pike	M	0.30	0.42	0.00080	0.029
307/ northern pike	F	0.11	0.37	0.00064	0.031
RBCs mg/kg		0.0021	0.14 methyl Hg	0.0093	0.0016

(1) Data from USGS (2002)

(2) M - male, F – female

Table 11 – Analytes Detected in Yukon River Salmon Collected at The Rapids and Beaver, Alaska[1]

Species	*Number of Samples* / *Sample Type*	*Arsenic Mean mg/kg Wet weight*	*Methyl Mercury Mean mg/kg Wet weight*	*DDX[2] Mean mg/kg Wet weight*	*PCBs[3] Mean mg/kg Wet weight*
Chinook	No. of samples	28	18	28	28
	Muscle	0.776	0.046	0.017	0.016
Chum	No. of samples	40[4]	40	39	40
	Muscle	0.069[5]	0.050	0.003	0.003
RBCs mg/kg		0.0021	0.14	0.0093	0.0016

(1) USF&WS (2004), unpublished data (April 9, 2004) – samples collected during 2001.

(2) Total DDTs

(3) Total PCBs (congener sum)

(4) Only 18 detects out of a total of 40 samples collected.

(5) The median concentration is given as it is the appropriate measure of central tendency for these data (calculated with NDs substituted as one half of the detection limit).

RBCs – Risk-based concentration values, EPA, Region 3.

Figures

Figure 1 – Location of Galena Airport, Campion AS, and Kalakaket WACS, Alaska.

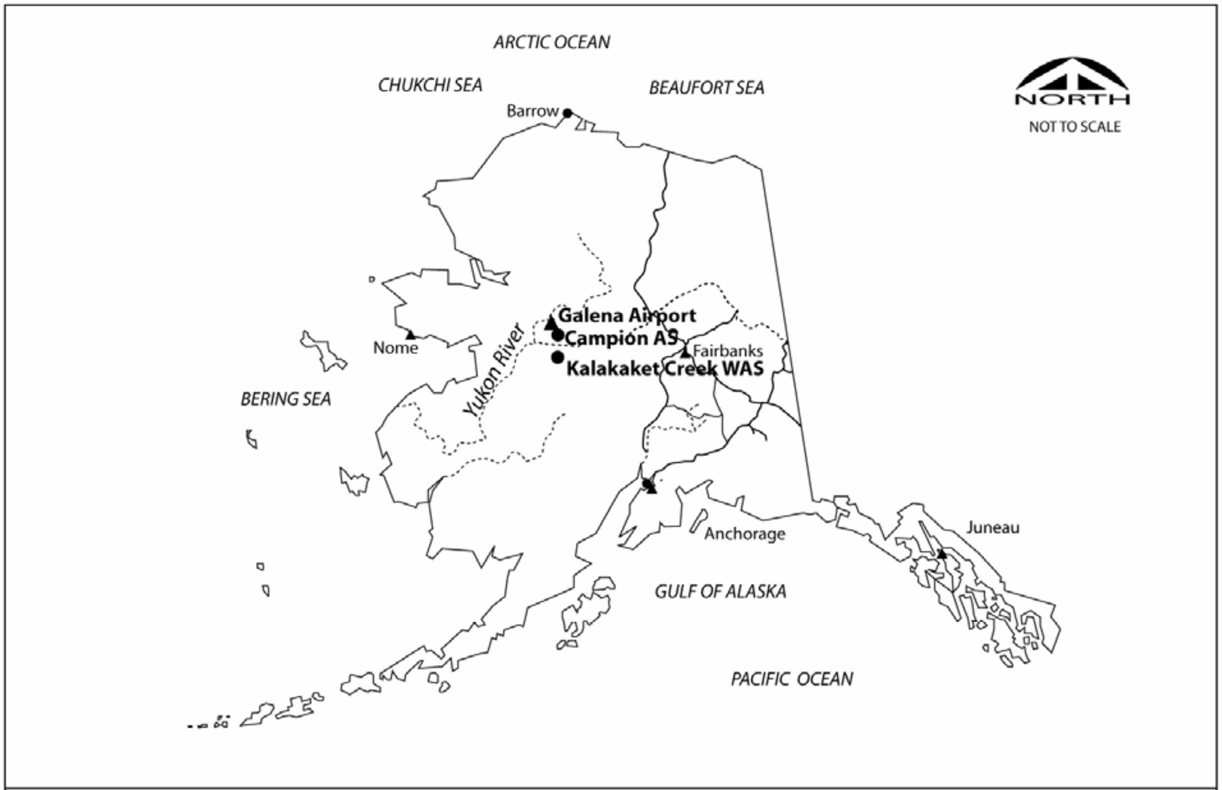
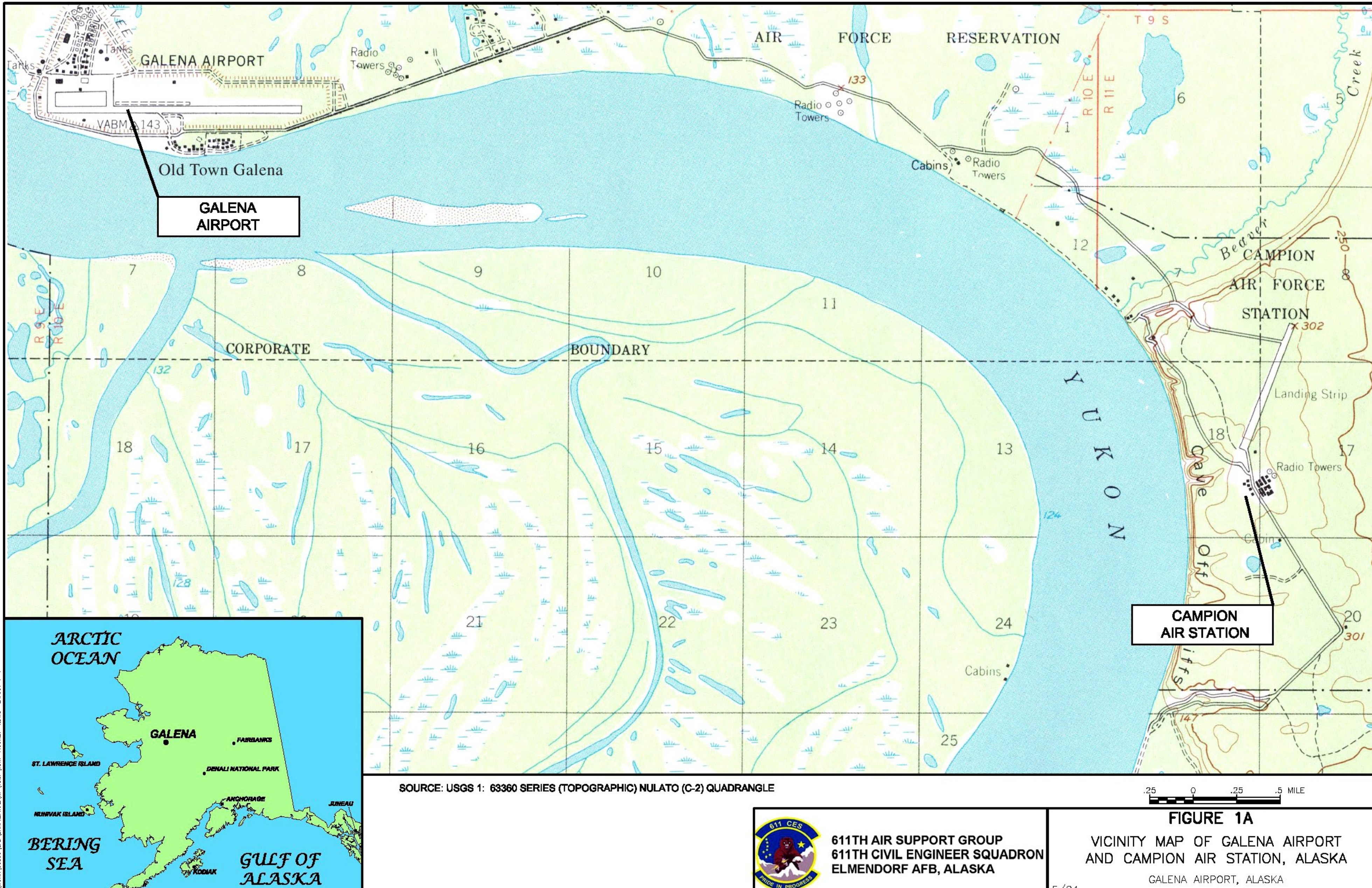


FIGURE 1
Installation Location Map



SOURCE: USGS 1: 63360 SERIES (TOPOGRAPHIC) NULATO (C-2) QUADRANGLE

.25 0 .25 .5 MILE

611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

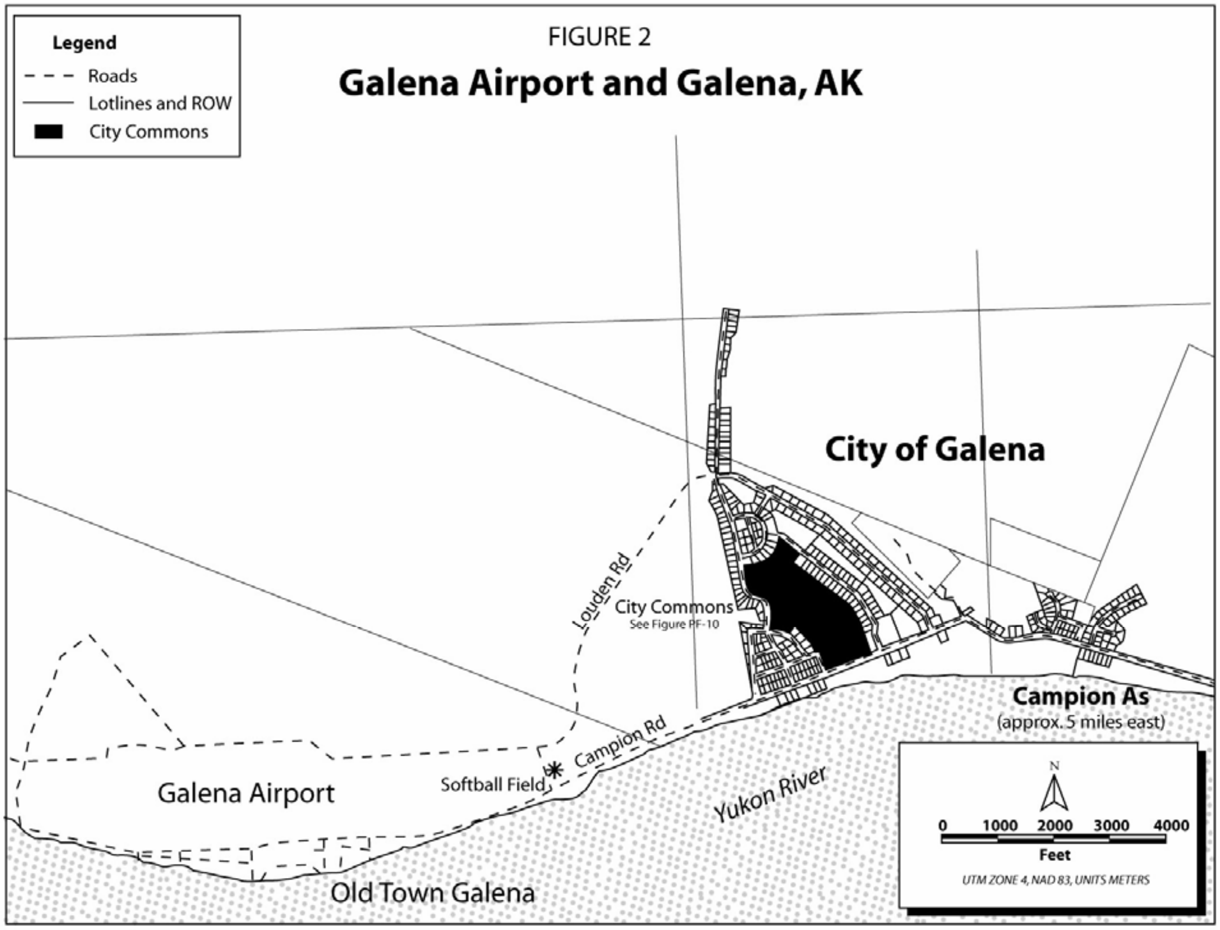
FIGURE 1A

VICINITY MAP OF GALENA AIRPORT AND CAMPION AIR STATION, ALASKA

GALENA AIRPORT, ALASKA

5/04

Figure 2 – Galena Airport and Galena, Alaska.



DATE OF PHOTOGRAPHY: 2002

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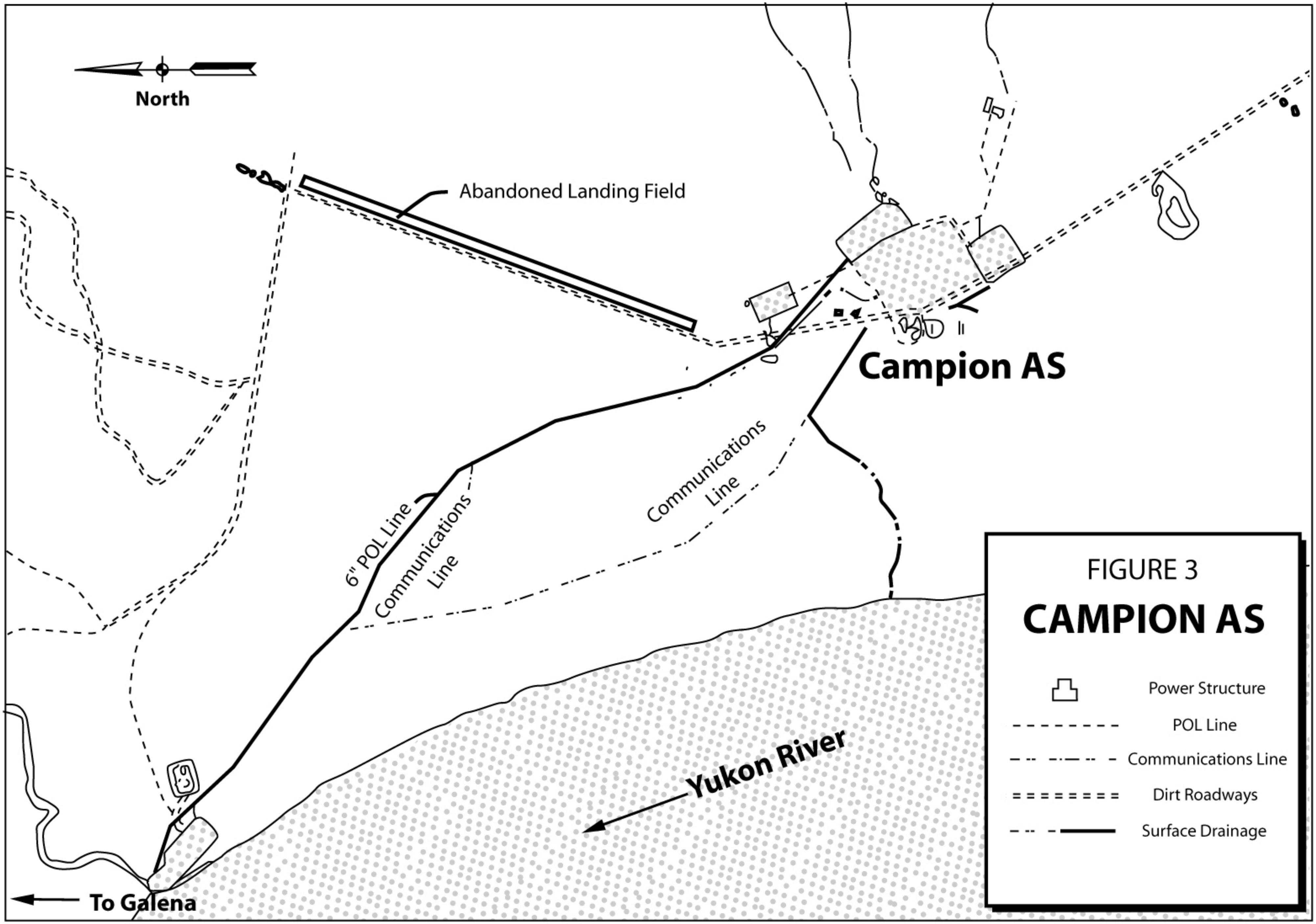
ELMENDORF AFB, ALASKA

FIGURE 2A

GALENA AIRPORT SITE LOCATIONS

GALENA AIRPORT, ALASKA

5/04



North
Abandoned Landing Field
Campion AS
6" POL Line
Communications Line
Communications Line
Yukon River
To Galena
FIGURE 3
CAMPION AS
Power Structure
POL Line
Communications Line
Dirt Roadways
Surface Drainage

Figure 3A – Campion Air Station Site Locations.

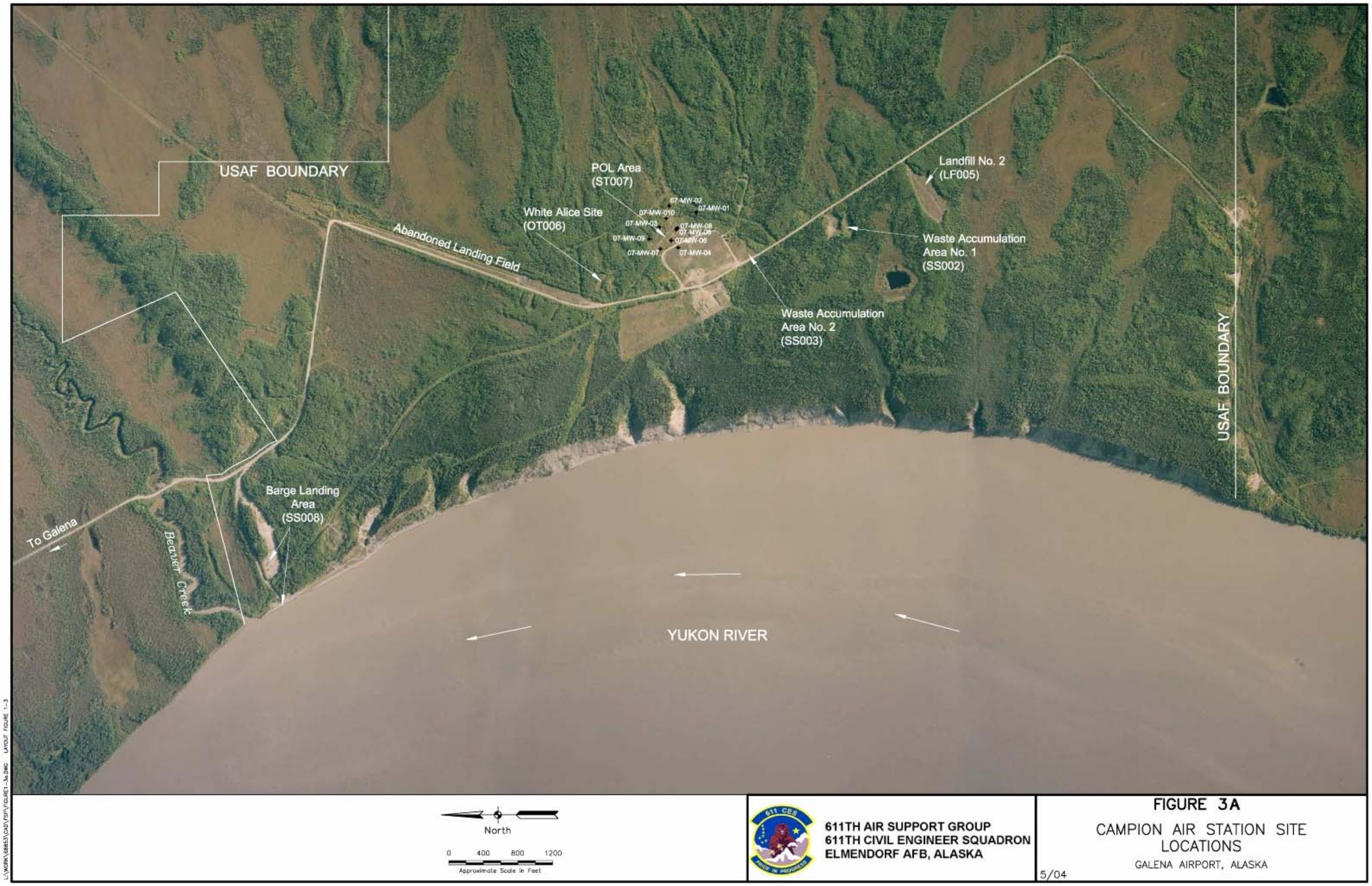
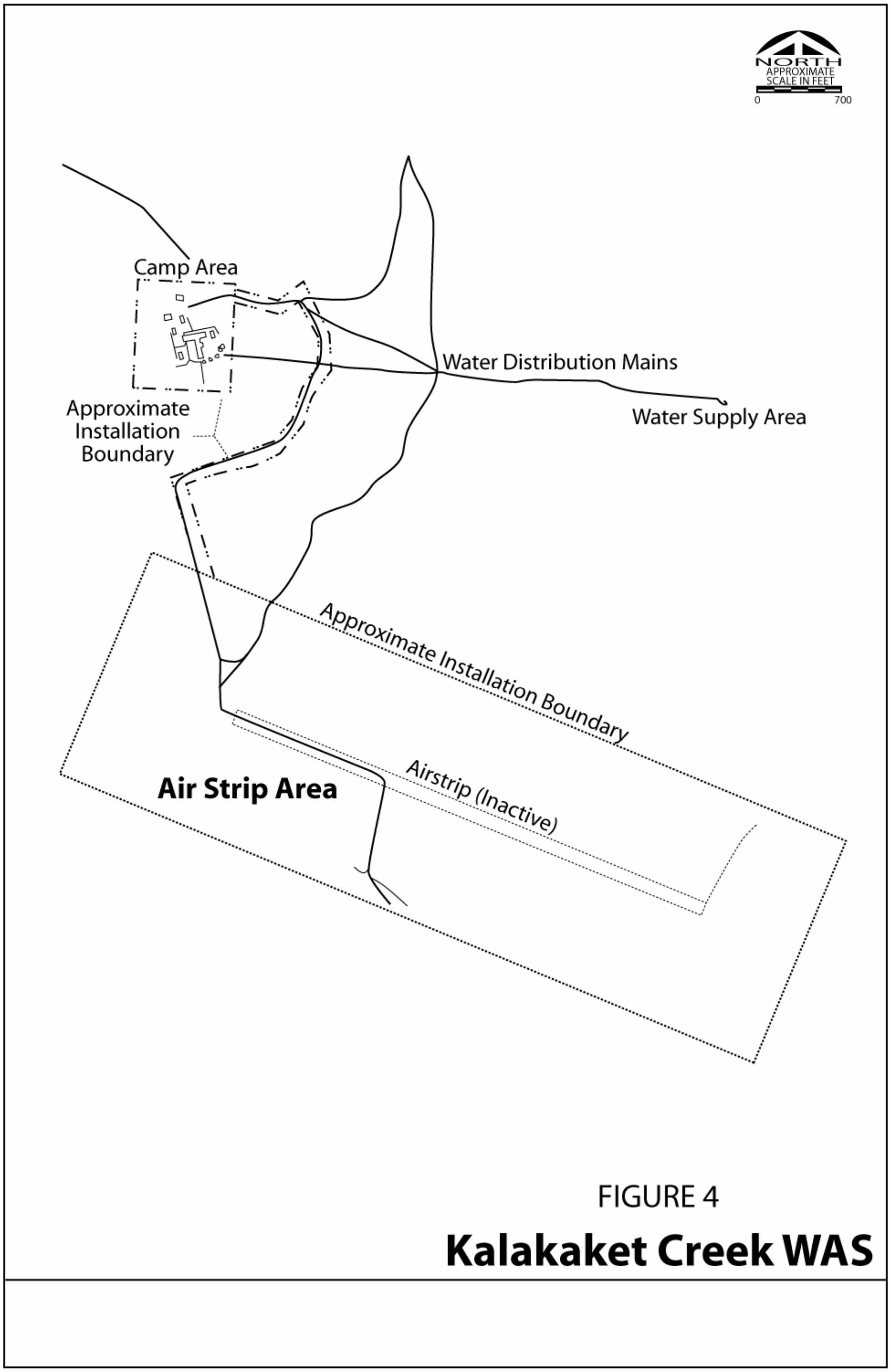


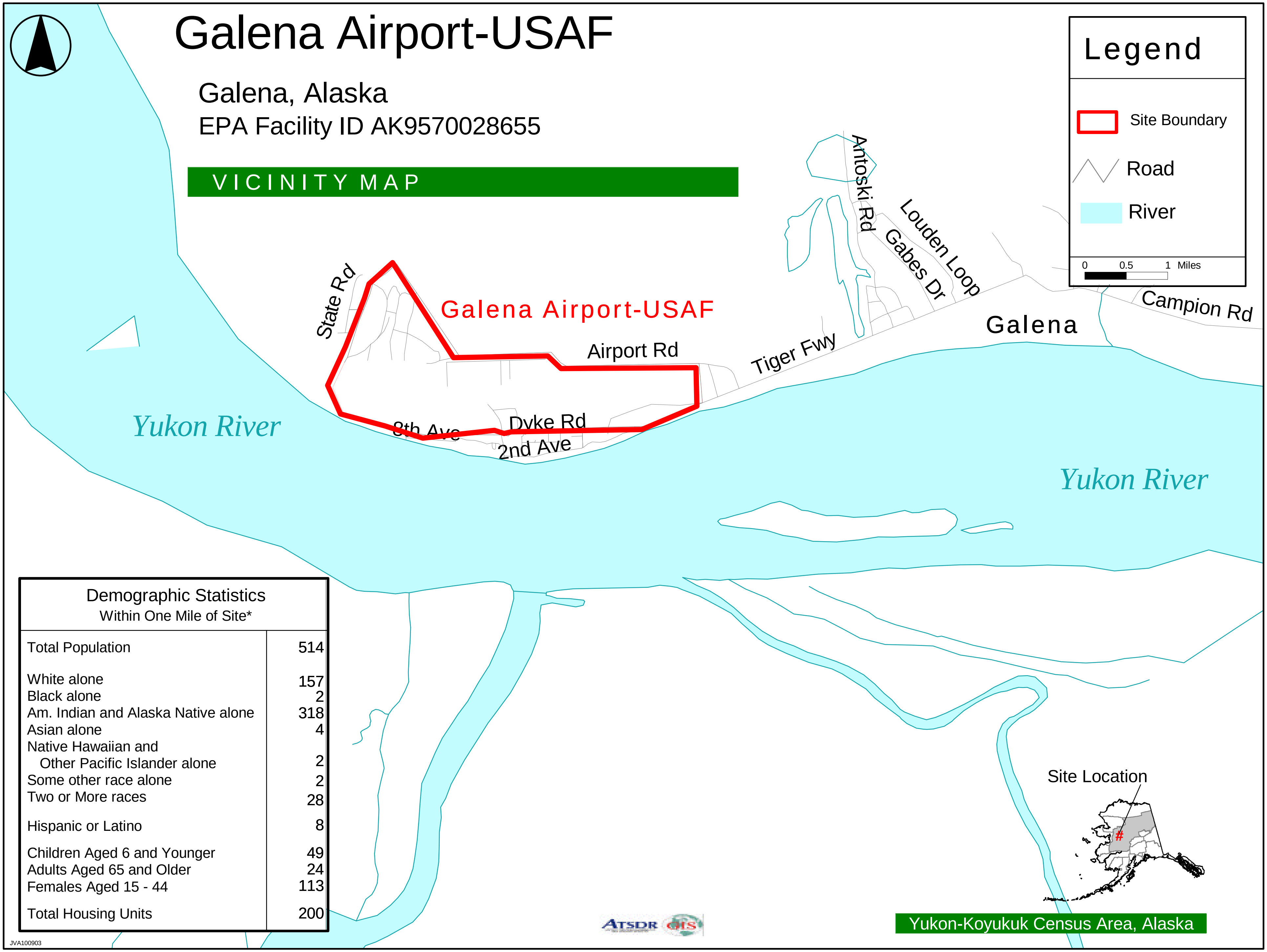
Figure 4 – Kalakaket Creek WACS



Galena Airport-USAF

Galena, Alaska
EPA Facility ID AK9570028655

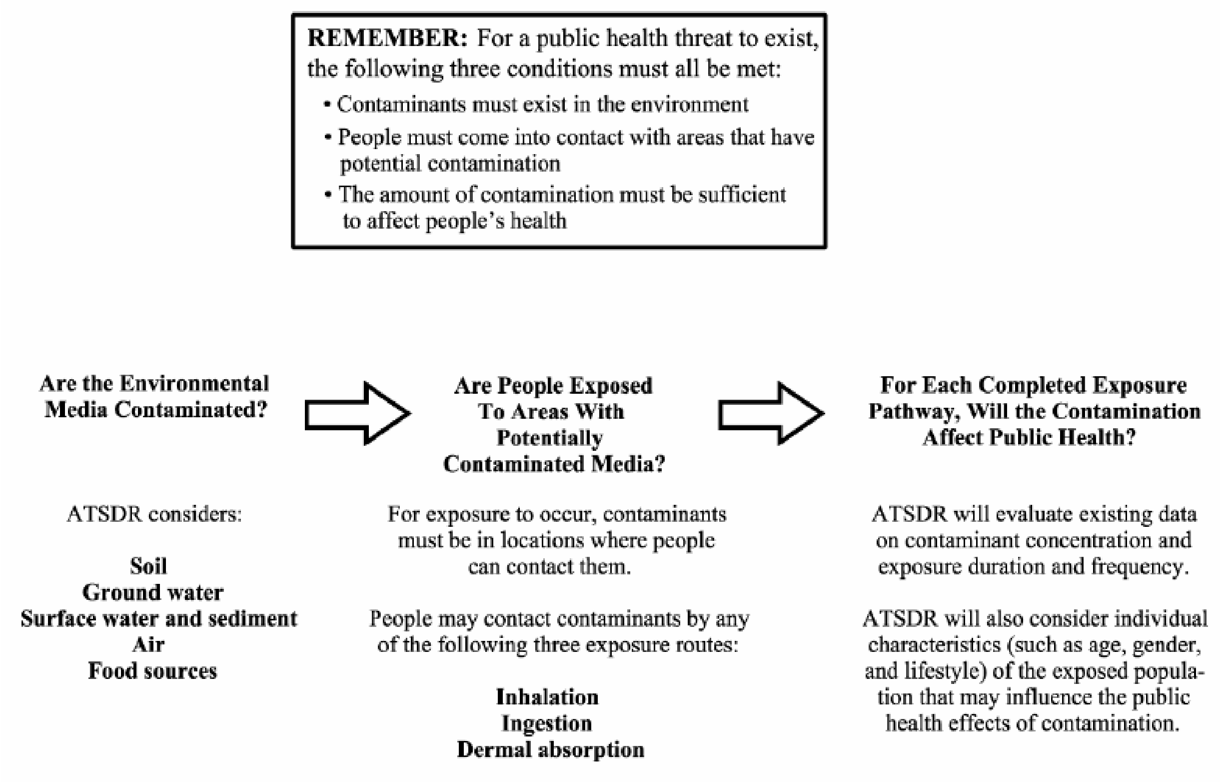
VICINITY MAP



Demographic Statistics
Within One Mile of Site*

Total Population	514
White alone	157
Black alone	2
Am. Indian and Alaska Native alone	318
Asian alone	4
Native Hawaiian and Other Pacific Islander alone	2
Some other race alone	2
Two or More races	28
Hispanic or Latino	8
Children Aged 6 and Younger	49
Adults Aged 65 and Older	24
Females Aged 15 - 44	113
Total Housing Units	200

Figure 6 – ATSDR Exposure Evaluation Process



Appendix A: Comparison Values

CREG: Cancer Risk Evaluation Guide, a highly conservative value that would be expected to cause no more than one excess cancer in a million persons exposed over time.

EMEG: Environmental Media Evaluation Guide is a media-specific comparison value that is used to select contaminants of concern. Levels below the EMEG are not expected to cause adverse noncarcinogenic health effects.

MRL: Minimal Risk Level is an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

RBC: Risk-Based Concentration, a contaminant concentration that is not expected to cause adverse health effects over long-term exposure.

RMEG: Reference Dose Media Evaluation Guide is a lifetime exposure level at which adverse, noncarcinogenic health effects would not be expected to occur.

Appendix B: ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Absorption – The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute – Occurring over a short time [compare with chronic].

Acute exposure – Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect – A change in body function or cell structure that might lead to disease or health problems

Aerobic – Requiring oxygen [compare with anaerobic].

Ambient – Surrounding (for example, ambient air).

Anaerobic – Requiring the absence of oxygen [compare with aerobic].

Analyte – A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Background level – An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation – Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic uptake – The transfer of substances from the environment to plants, animals, and humans.

Biota – Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden – The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

Cancer – Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk – A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen – A substance that causes cancer.

Central nervous system – The part of the nervous system that consists of the brain and the spinal cord.

CERCLA – see Comprehensive Environmental Response, Compensation, and Liability Act of 1980

Chronic – Occurring over a long time [compare with acute].

Chronic exposure – Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Comparison value (CV) – Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway – see exposure pathway.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) – CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration – The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant – A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal – Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact – Contact with (touching) the skin [see route of exposure].

Detection limit – The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention – Measures used to prevent a disease or reduce its severity.

Disease registry – A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD (DoD) – United States Department of Defense.

Dose (for chemicals that are not radioactive) – The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals) – The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship – The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media – Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism – Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA – United States Environmental Protection Agency.

Epidemiology – The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure – Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment – The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway – The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or are exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Feasibility study – A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, methods that will work well.

Geographic information system (GIS) – A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Groundwater – Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life (t½) The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half-life is the amount of time necessary for one-half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard – A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat) – The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste – Potentially harmful substances that have been released or discarded into the environment.

Health consultation – A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education – Programs designed with a community to help it know about health risks, and how the community can reduce such risks.

Health investigation – The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion – The process of enabling people to increase control over, and to improve, their health.

Health statistics review – The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard – The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence – The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion – The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation – The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure – Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Lowest-observed-adverse-effect level (LOAEL) – The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Metabolism – The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite – Any product of metabolism.

mg/kg – Milligram per kilogram.

mg/cm2 – Milligram per square centimeter (of a surface).

mg/m3 – Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration – Moving from one location to another.

Minimal risk level (MRL) – An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Mortality – Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL) – EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard – A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL) – The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard – A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL – see National Priorities List for Uncontrolled Hazardous Waste Sites.

Pica – A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume – A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure – The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population – A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP) – A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb – Parts per billion.

ppm – Parts per million.

Prevalence – The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevention – Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session – An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period – An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action – A list of steps to protect public health.

Public health advisory – A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA) – An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard – A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories – Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement – The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance – The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting – A public forum with community members for communication about a site.

Radioisotope – An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide – Any radioactive isotope (form) of any element.

RCRA – see Resource Conservation and Recovery Act (1976, 1984).

Receptor population – People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD) – An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry – A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation – The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA) – This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA – RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD – see reference dose.

Risk – The probability that something will cause injury or harm.

Risk reduction – Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication – The exchange of information to increase understanding of health risks.

Route of exposure – The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor – see uncertainty factor.

SARA – see Superfund Amendments and Reauthorization Act.

Sample – A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size – The number of units chosen from a population or an environment.

Solvent – A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination – The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations – People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics – A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance – A chemical.

Superfund – see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA).

Superfund Amendments and Reauthorization Act (SARA) – In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water – Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance – see public health surveillance.

Survey – A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect – A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Toxic agent – Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile – An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology – The study of the harmful effects of substances on humans or animals.

Tumor – An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor – Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard – A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs) – Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH) (http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

Appendix C: Home Water Treatment Options

Please note that the well water should be tested before deciding on which form of water treatment to use. Additional information on commercially available, home water treatment system alternatives can be found at Internet locations such as http://www.goodh2o.com .

Arsenic

Arsenic is not readily soluble in water; therefore, it can be removed by many conventional home water treatment processes. As much as 40–70% of inorganic arsenic can be removed by activated carbon filtration systems. About 90–100% reduction can be achieved by reverse osmosis and anion exchange systems. Simple distillation, although not effective for large volumes of water, will remove about 98–99% of the arsenic. Organic arsenic can be removed by oxidation of the organic material and subsequent coagulation. Activated carbon and reverse osmosis are also effective in reducing organic forms of arsenic.

Iron

Iron can exist in two different forms in well water: ferrous or oxidized ferric iron. Water containing ferrous iron is usually clear when drawn. The ferrous form of Fe can be removed by a water softener. Depending on the size of the water softener about 5–10% of ferrous iron can be removed. Water containing oxidized ferric iron is usually reddish-brown when drawn at the tap. Ferric iron can be partially removed by the use of a sediment filter before the water softener.

Other, more effective treatment options, which also require more frequent maintenance, include oxidizing filters and colloidal-type filters. The utility and efficiency of these forms of water treatment systems depend on the pH (a measure of the degree of acidity or alkalinity) of the water. Catalytic filters systems — which remove manganese as highly efficient and can potentially remove up to10 ppm iron. Pumice filtration systems can remove up to 25 ppm ferric and ferrous iron.

If iron is bound to organic materials, then oxidation is required to destroy the organics before effective removal of the iron. Oxidization and removal of iron can be achieved through the use of a system that combines the use of a microionizer and an air vent tank. This approach requires subsequent filtration of the iron from the water, or back flushing of the iron that has accumulated in the bottom of the storage tank. Chlorination and subsequent filtration are very effective for iron removal, but the chlorine must be carefully metered into the raw water before [filling?] the storage tank and the chlorinated water must be held for at least 20–30 minutes before filtering. An activated carbon filter will remove the iron and excess chlorine. Chlorination is effective for non-acidic waters with a pH of 7 or greater.

Manganese

Manganese can be very difficult to remove from well water. Several factors affect the level of manganese in water, including the pH, the oxidation state of the water, and the presence of other compounds or metals such as iron. Usually, the removal of iron from the water also reduces the manganese level of the water. If the water is non-acidic, partial removal of manganese is possible with a sodium-exchange water softener.

Like iron, organic material can tie up manganese and, therefore, destruction of the organic material is often an important step in manganese removal. Systems using oxidizing-type filters or activated carbon filters used subsequent to chlorination could be the most effective combination of methods to reduce the manganese level of the water. A holding time of at least 20 to 30 minutes after chlorination is necessary to achieve both manganese and iron removal.

Appendix D: Health Effects of Benzene Inhalation

Most people can begin to smell benzene in air at 1.5–4.7 ppmv (1500–4700 ppbv). Breathing benzene at acute levels ranging from 700 to 3,000 ppmv (700,000 to 3,000,000 ppbv) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. In most cases people will stop feeling these effects when they stop being exposed and begin to breathe fresh air (ATSDR 1997b).

The major effects of benzene exposure result from long-term (>365 days or longer) exposure. Sustained benzene exposure affects the blood. Benzene can cause harmful effects on bone marrow and can cause decreases in red blood cells leading to anemia. Results can also include excessive bleeding and changes in the immune system increasing the chance of infection and perhaps lowering the body's defense against cancer (ATSDR 1997b).

The toxicological profile for Benzene compiled by ATSDR (1997b) includes an extensive, exhaustive review of numerous laboratory and work place studies of exposures to benzene. At least one study found no adverse hematological (blood) effects in workers in a Texas oil refinery — at very low levels of benzene exposure. Those workers were exposed to 0.53 ppmv (530 ppbv) for 1 to 21 years (Tsai et al 1983).

Short-term inhalation exposure of mice to benzene resulted in reduction of some immune associated processes (Rozen MG et al 1984). This study was used to establish conservatively the lowest-observed-adverse-effects level (LOAEL) for acute inhalation exposure (14.7 ppmv or 14,700 ppbv — the human equivalent concentration). The conservative acute inhalation MRL of 50 ppbv was derived from this study (ATSDR 1997b).

Research done by Li et al (1992), found neurological effects such as changes in response time and in grip strength, resulted from a 30-day exposure period. The onset of these behavioral changes occurred at doses much lower than those that caused the expected changes in bone marrow cells. Thus, these less-serious effects of neurological changes at 0.33 ppm (330 ppbv - human equivalent concentration) were selected as the basis for the intermediate LOEAL. Using this study, ATSDR (1997b) derived a conservative intermediate inhalation MRL of 4 ppbv.

It should be emphasized, however, that even the maximum benzene levels detected in 2002 are below the LOAEL level of 330 ppbv. Thus, non-carcinogenic health effects are unlikely to arise from exposure to the 2002 benzene levels in GAVTC indoor air. The safety of those exposure levels is further emphasized or strengthened by the daily, weekly, and yearly interruptions of attendance or utilization of GAVTC, which reduces the effective exposure of both students and teachers.

ATSDR (1997b) is a review of the literature on carcinogenic effects of benzene inhalation exposure. Of the several studies that dealt with cancer endpoints and for which cancer effect levels (CELs) were determined, the lowest exposures resulting in an incidence of leukemia were from a time-weighted benzene exposure of 0.3 to 35 ppmv (300 to 35,000 ppbv). Those exposures occurred in a chemical manufacturing factory for varying time periods from 1940 to 1970 (Ott et al 1978). That historical study of 594 workers found 3 cases of leukemia as compared to 0.8 expected cases. ATSDR (1997b) also noted other studies that found CEL values ranging from 1 to 200-ppmv benzene for exposures of length varying from 1 to 40 years duration.

One study showed no leukemia deaths following benzene exposures to concentrations less than one ppmv (Tsai et al 1983). In this study of refinery workers the median benzene inhalation exposures ranged from 0.14 to 0.53 ppmv (140 to 530 ppbv). These levels are well in excess of the average benzene levels detected at GAVTC in either 2002 or 2003–2004.

Appendix E: Responses to Public Comments

The Agency for Toxic Substances and Disease Registry (ATSDR) received the following comments during the public comment period (August 2, 2005 to September 19, 2005) for the Galena Airport Public Health Assessment. For comments that questioned the validity of statements made in the public health assessment, ATSDR verified or corrected the statements.

Comment	How Addressed
Please use 2004 census data, if available	ATSDR reviewed the currently compiled census data for the Galena area. The total population reported in those data is slightly greater that the population numbers used in the public health assessment. This difference is due largely to the differing geographic boundaries used to compile the data. Because the population changes are small and do not affect the conclusions reached in the assessment, ATSDR did not use the 2004 data.
Provide the education or a synopsis of the education provided.	ATSDR made the suggested additions at page 65.
For ease of reading there should be a transition into the issues related to the Public Health Assessment. The previous pages were an introduction into how a PHA works. This section details the specific concerns of the community and ATSDR's evaluation of the risks	ATSDR made the suggested edits where necessary on those pages describing the issue, conclusion(s), and discussion.
The 611 CES conducted influent samples during 2004 and effluent samples on a monthly basis. This was done by the AF independent of the ATSDR evaluation to mitigate community concerns (that) the drinking water at Galena Airport was contaminated. This data will be provided as backup to ATSDR's conclusions on water in this section.	ATSDR review the additional data submitted for potable water samples collected from the Galena Airport system. The text was supplemented reflect these results.
Continued monitoring of the quality of the treated water will ensure the safety of the drinking water supplied by this system in the future. While this is a good recommendation and the AF will continue to ensure drinking water meets requirements for public systems, the recommendations carry no endpoint.	Both the Galena Airport and city of Galena wells are considered municipal or public wells. As such, both state and federal law require periodic monitoring to ensure that safe drinking water standards are met.
The use of home water systems is an individual assessment of his or her private water; however, the technical discussion is too verbose for the reader. The discussion should be a Brita Filter, a water softener, etc. Also, please note that in remote Alaska drinking water sampling and who may pay for the sampling should be evaluated as a resource (i.e. indicate who or what government agency can provide this sampling, etc.). To benefit the community some federal, state, and local resources should be identified to assist in the cost of this recommendation.	ATSDR does not make specific product endorsements. The technical information was provided to facilitate selection of filtering systems that meet the consumer's needs. ATSDR recommendations are nonbinding, but ATSDR does make an effort to obtain the commitment of agencies to implement those recommendations. No such commitment has been made for this recommendation.

Comment	How Addressed
It should be noted that the GAVTC facility does not meet the requirements for handling hazardous materials (fuels, etc.) because the facility does not have the required makeup air, venting, etc. that would be installed at a normal vocational school recently constructed in the United States.	ATSDR's focus has been to evaluate the potential health effects that could arise from historical exposure to contaminants in indoor air at GAVTC, regardless of the status of air handling systems within the structure. The beneficial aspects of the subsurface depressurization system on historical and existing indoor air quality were recognized in the assessment.
It should be noted that he classroom and contact time at the facility have fluctuated over the last three years. However, with the running of the subsurface depressurization system (that meets) performance specifications for two air exchanges per day, the GAVTC facility is safe no matter how many contact days.	ATSDR added additional information regarding GAVTC usage during 2004 and evaluated the exposure implications of that data. Additional evaluation was added to the Assessment in that section.
Please provide a synopsis of the training for tribal clinicians.	ATSDR added a summary of the training provided.
Background levels of metals in of naturally occurring metals: ADEC would like to point our that both the ADEC and the U.S. Air Force (USAF) agreed that the background levels study (reported in the U.S. Air Force, 1996) was insufficient to establish statistically rigorous background concentrations of metals in groundwater, surface water and soil at Galena Airport and Campion Air Station. In proceeding with a Human health Risk Assessment, currently under development, ADEC and USAF agreed not to use the afore mentioned background levels.	ATSDR acknowledges that the original study of natural background levels of metals may have been inadequate. However, the precise determination of background levels at this site does not have any public health consequences, given the evaluation methods outlined. ATSDR recognizes that natural metal levels are high throughout the Yukon River drainage.
The detection of chloroform in the in the raw water of the Galena Airport Municipal System is in conflict with the statement under the "Treated Water Quality" section. Note that chloroform is a potential environmental contaminant resulting from the reductive dechlorination of carbon tetrachloride.	ATSDR agrees that chloroform can arise for environmental contamination. The analysis of the raw water of the Galena Airport wells includes occasional detections of chloroform at lower levels than the levels of TTHMs in the treated water. The disinfection of the drinking water gives rise to disinfection byproducts including chloroform. Regardless of the source of chloroform, the levels of chloroform and the TTHMs measured are below levels of health concern.
In evaluating the potential health threat posed by the indoor air at the GAVTC, the chronic inhalation minimum risk level (MRL) was not used for evaluating exposure for teachers. However, it is stated that the teachers are assumed to be working at GAVTC for ten years, and that a chronic MRL is used for exposures longer than one year.	ATSDR has not determined a Chronic MRL for benzene at this time. Thus, the longest-duration evaluation level available is the intermediate MRL.
The most recent exposure assumptions for teachers and students in the GAVTC provided by the Galena City Schools are for longer times and increased frequency relative to the exposure assumptions used by ATSDR. Please consider using these more conservative exposure assumptions (attached to the ADEC comments) in performing you evaluation of the indoor air at the GAVTC.	ATSDR reviewed the new contact information submitted and made additions to the text. While the potential exposure times change slightly no adverse health effects are likely to result from these exposure durations.

Comment	How Addressed
Please double check the reference to a water drainage pipe on the west side of the Million Gallon Hill. ADEC is aware of petroleum contamination resulting from drainage of water from the underground tanks on the east side of Million Gallon Hill, but not on the west side.	ATSDR corrected this statement.
The discussion of petroleum contamination at Million Gallon Hill implies that natural attenuation is the remedial strategy for this site. Please note that the USAF has been operating three air injection, bioventing systems at the Million Gallon Hill and the adjacent Missile Storage Area.	ATSDR added text to page 44 clarifying this section.
Consider rephrasing the last sentence of the first paragraph on page 48, under the section of the Public Comment release considering contamination of traditional subsistence foods. As written currently, this sentence appears to conflict with the first conclusion stated on page 44 and the last two paragraphs on page 47.	ATSDR agrees that the sentence, meant only to convey potential, appeared to conflict with the previously stated conclusions. The sentence was deleted.
It is worth noting that sampling at the former Kalakaket Creek White Alice Station has documented polychlorinated biphenyl contamination in the surface soil at several locations. Maximum concentrations at the various locations range from approximately 3 to 6,700 mg/kg of Aroclor 1260. The report that provides this sampling data is available at : http://www.adminrec.com/Documents3/Adminrec/Kalakaket/CD1/Data/00001009.pdf Please consider this data in your discussion on page 49 of the Public Comment release of the pha.	ATSDR reviewed the referenced report and the detection of PCBs in surface and subsurface soils. PCBs, in a range of concentrations, were found in seven areas and appear to reflect leaks from storage drums, spills near transformers, and other accidental releases. The data also indicate that the PCBs detected were, at least in part, areas of contamination that were not adequately removed during a USAF 1984 site clean-up. The maximum detection of PCBs was located in subsurface soil at the bottom of a trench excavated during soil removal activities. Additional text was added to the Assessment.