Public Health Assessment for

BUNKER HILL MINING AND METALLURGICAL COMPLEX OPERABLE UNIT 3
(a/k/a COEUR D'ALENE RIVER BASIN)

KOOTENAI AND SHOSHONE COUNTIES, IDAHO WESTWARD TO
SPOKANE AND STEVENS COUNTIES, WASHINGTON

EPA FACILITY ID: IDD048340921

MARCH 26, 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.

PUBLIC HEALTH ASSESSMENT

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KOOTENAI AND SHOSHONE COUNTIES, IDAHO WESTWARD TO
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Prepared by:

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

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FOREWORD

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

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data 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 determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

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

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

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

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

Letters should be addressed as follows:

Agency for Toxic Substances and Disease Registry
ATTN: Records Center
1600 Clifton Road, NE (Mail Stop E-60)
Atlanta, GA 30333

ACRONYMS

AIRS	Aerometric Information Retrieval System of EPA
ATSDR	Agency for Toxic Substances and Disease Registry
CdA	Coeur d'Alene
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPD	Chronic Obstructive Pulmonary Disease
CREG	Cancer Risk Evaluation Guide
CUA	Common Use Area
DHHS	U.S. Department of Health and Human Services
DWEL	Drinking Water Equivalent Level of EPA
EAL	EPA Action Level for Lead in drinking water
EMEG	Environment Media Evaluation Guide
EMEG-cp	Environmental Media Evaluation Guide for chronic exposure of children displaying pica behavior
EMEG-ip	Environmental Media Evaluation Guide for intermediate duration exposure of children displaying pica behavior
EPA	U.S. Environmental Protection Agency
ICP	Institutional Control Program
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDOH	Idaho Division of Health
LOAEL	Lowest-Observed-Adverse-Effect-Level
LTHA	Life-time Health Advisory
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
MRL	Minimal Risk Level
NA	Not Applicable
NMMAPS	National Morbidity, Mortality, and Air Pollution Study
NPL	National Priorities List
NTNC	Non-transient non-community
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PHA	Public Health Assessment
PHC	Public Health Consultation
PHD	Panhandle Health District
PM	Particulate Matter
ppb	parts per billion (µg/kg or µg/L) [micrograms of contaminant per kilogram of medium or micrograms of contaminant per litre of medium]
ppm	parts per million (mg/kg) [milligrams of contaminant per kilogram of medium]
RBC-n	Risk-Based Concentrations for non-cancer hazards resulting from exposures to contaminants in residential soils
RfD	Reference Dose

RMEG	Reference dose Media Evaluation Guide
RMEG-p	Reference dose Media Evaluation Guide for exposure among children who exhibit soil pica behavior
SDWA	Safe Drinking Water Act
SSL	EPA Soil Screening Level
SV	Screening Value
SWA	Source Water Assessment
TCdA	Trail of the Coeur d'Alenes
TSP	Total Suspended Particulates
UPRR	Union Pacific Railroad
URS	URS Grenier (an EPA contractor)
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDOE	Washington Department of Ecology
µg/kg	micrograms of contaminant per kilogram of medium
µg/kg/day	micrograms of contaminant per kilogram of body weight per day
µg/dL	micrograms of contaminant per deciliter of body fluid
µg/L	micrograms of contaminant per litre of medium
$\mu g/m^3$	micrograms of contaminant per cubic meter of air

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EXECUTIVE SUMMARY

A. The Site

The Bunker Hill Mining and Metallurgical Complex was added to the National Priorities List (NPL) in 1983. This public health assessment (PHA) addresses only the Bunker Hill Operable Unit 3 (Bunker Hill OU3), also known as the Coeur d'Alene (CdA) River Basin site. The site includes the CdA River Basin, extending from the Idaho/Montana border westward to the Spokane arm of Lake Roosevelt in the State of Washington.

The CdA River Basin site runs along the CdA River, through Lake CdA, and into the Spokane River. It includes areas in Kootenai and Shoshone counties in northern Idaho and Spokane and Stevens counties in Washington. This PHA evaluation does *not* include the 21-square-mile Bunker Hill Superfund area known as the "Box."

Metals released during mining and smelting operations contaminated the environment within the CdA River Basin. Waste ore concentrates were also deposited throughout the CdA River Basin due to spillage from railcars during transportation. This public health assessment (PHA) addresses issues related to these metals.

The PHA divides the site into two main areas. Areas east of the Box include the South Fork CdA River upstream from the Box as well as the towns of Wallace and Mullan. Areas west of the Box include the drainage basin for Pine Creek and the region surrounding the confluence (near Kingston, Idaho) of the North Fork CdA River (which is actually north of the Box) and South Fork CdA River (downstream of the Box), tributaries flowing into the South Fork CdA River at the Box, Lake Coeur d'Alene and the entire length of the CdA River. This area also includes the towns of Kingston and Harrison and the area known as the "Lower Basin."

This document also discusses the Spokane River and the Mullan to Harrison Branch Union Pacific Railroad right-of-way which is now known as the Trail of the Coeur d'Alenes (TCdA). The area of the Spokane River reviewed covers river segments within the state of Idaho westward to the Spokane arm of Lake Roosevelt in the state of Washington.

Most activities that occurred within the Box (with the exception of the TCdA) are only mentioned in this document as necessary for comparison with activities occurring outside the Box. The Box area has been evaluated in previous ATSDR documents (ATSDR 2000c, ATSDR 2000d, and ATSDR 2000e).

The area's major surface water bodies include the Coeur d'Alene River, Lake Coeur d'Alene, Lake Spokane, and the Spokane River. These water bodies support wildlife and are used for recreation, including fishing, boating and swimming. The CdA Tribe uses the lake for traditional as well as aesthetic purposes.

B. Environmental Contaminants

The contaminant of greatest concern for human health impacts at the site is lead. In addition, ATSDR has identified seven other chemicals of potential human health concern within the CdA River Basin site. These chemicals are aluminum, antimony, arsenic, cadmium, iron, manganese, and zinc. Mercury has also been identified as a contaminant of potential health concern based on concentrations detected in fish samples from Lake CdA. Polychlorinated biphenyls (PCBs) are of concern in fish caught in some segments of the Spokane River, however, the PCBs are not thought to be related to former mining and smelting activities within the CdA River Basin site.

Following are summaries of findings from site investigations, sorted by media.

Surface Soil and Household Dust

Surface soil and household dust are the media of greatest concern within the CdA River Basin site. For this site, on the basis of modeling and bioavailability studies, EPA chose a tiered approach to soil cleanup of residential yards with lead concentrations between 700 parts per million (ppm) and 1,000 ppm lead, which is 700-1,000 milligrams of lead per kilogram of soil (mg/kg). For those yards, a barrier, such as vegetation was required. For residential yards with lead levels above 1,000 ppm, soil removal and soil barrier were selected.

Many tests in residential soils and household dusts throughout the site detected lead concentrations in excess of 400 ppm. EPA's national screening level for lead in residential soil is 400 ppm. Based on existing information, there does not appear to be mining-related contamination in the residential and commercial areas of the cities of Coeur d'Alene, Harrison, and Post Falls; however, in the past concentrations of lead and zinc were detected in the soils and sediments of Harrison Beach. This contamination was remediated as part of a Union Pacific Railroad (UPRR) removal action (EPA 2002b).

Non-residential soils near mining sites and areas that are often flooded appear to have the highest level of contamination. Common use areas (CUAs) are public access areas such as beaches, parks, and campgrounds. The highest surface soil concentrations of lead appeared in CUAs east of the eastern shore of Lake Coeur d'Alene. Most of the samples with concentrations higher than 1,000 ppm came from CUAs along the CdA River and the South Fork CdA River. Formal recreational areas (e.g., boat ramps, picnic areas) with lead concentrations greater than 700 ppm are to be capped.

No lead concentrations higher than 1,000 ppm were observed in CUAs along Lake Coeur d'Alene and only infrequently along the Spokane River (Idaho side).

EPA also selected an arsenic cleanup level of 100 ppm.

To deal with household dust contamination EPA has chosen a variety of programs to assist homeowners. These alternatives include capping of crawl spaces with sand or synthetic cover to prevent the generation of dust and tracking of soil into the home; cleaning of accessible attics and basements; a vacuum loan program; and interior cleaning (one-time basis plus monitoring).

Potable Water Sources

Currently, most water from regulated public and private water supply sources appears to be safe. According to EPA, all of the community and non-transient, non-community water supply systems in the Silver Valley are monitored to ensure they meet applicable standards. In addition, public water systems are regulated under the Safe Drinking Water Act (SDWA) and the State of Idaho. Community water systems are regulated by the State of Idaho.

Evidence suggests that some residents divert water from ponds and other non-regulated water bodies for potable use. Although ATSDR does not have the data from these non-regulated sources to evaluate, the history of contamination in this area suggests that some of these waters could pose a public health concern. This concern would be particularly strong in areas near piles of ore waste (i.e., “tailings”). Persons who take water from any non-regulated source should have the water tested.

Groundwater

Groundwater monitoring in the CdA River Basin site have detected elevated levels of metals, including lead, associated with mining wastes. The highest levels of contamination were detected downgradient from tailings piles, milling sites, and other sources of wastes.

Elevated metals concentrations also have been detected in the groundwater along the CdA River, a location relatively far from area mining sites. This fact suggests that the tailings may have impacted groundwater sources.

Surface Water

The extent of surface water contamination varies from location to location and from year to year. Metals deposits in sediments throughout the site, however, continue to contaminate surface water. While conditions have improved in areas of direct human contact, the fact remains that as contaminated sediments continue to move downstream, they will continue to impact downstream resources. As long as the sediments contain high levels of metals, surface waters will likely remain contaminated, especially when sediments are disturbed.

Sediment

Sampling detected elevated metals concentrations in surface sediments in many areas. These areas range from mining sites near the headwaters of the tributaries to the South Fork CdA River to downstream stretches of the Spokane River.

In some locations, metals-contaminated sediments are several feet thick. Over 75 million tons of contaminated sediments exist in Lake CdA (EPA 2002b). Migration of contaminated sediments is likely to continue and greatly increase the concentrations of these metals downstream.

While conditions have improved in areas of direct human contact, the fact remains that large quantities of contamination resides at the bottom of Lake CdA and a change in lake conditions would increase mobilization of those contaminants in a way that increases risk to unacceptable levels. This is a unique concern for the CdA Tribe as it impacts upon their fisheries. ATSDR concurs with the National Academy of Science's recommendations of further lake studies.

Lead was found in beach and shoreline sediments along the Spokane River at concentrations which exceed EPA's screening levels. The common use area (CUA) of greatest concern is the River Road 95 CUA. Potential exposure to lead via inhalation, ingestion, and dermal contact exists.

Aquatic Biota

Metals found at elevated levels in site sediments (e.g., lead, cadmium, mercury and zinc) also appear in many species of fish and shellfish throughout the area. Generally tissues in on-site fish and shellfish have been found to contain higher levels of metals than fish and shellfish from waters in northern Idaho not affected by the mining wastes.

Metals levels in fish vary, however, from one tissue type to the next. Many studies of area fish have found consistently that metals contamination levels tends to be lower in parts people usually eat (fillets) than in other parts, such as livers and kidneys. However, ATSDR has been told that many members of the Coeur d'Alene Tribe as well as some other CdA River Basin residents cook/can and eat the entire fish.

ATSDR and the Idaho Division of Health (IDOH) released a public health consultation (PHC) in 2003 (see appendix I) which evaluated fish collected from Lake Coeur d'Alene. The findings supported a fish consumption advisory issued for Lake Coeur d'Alene. The advisory was issued due to the concentration of lead, mercury, and arsenic in fish samples.

In August 2000, the Spokane Regional Health District issued a fish consumption advisory based on the concentration of lead in fish sampled from the Spokane River. That advisory was later amended to include polychlorinated bipenyls (PCBs). The PCBs are not believed to be related to mining contamination from the CdA River Basin site.

Terrestrial Biota

Sampling studies have detected metals in many site plants and animals. Almost every bird and mammal sampled had metals contamination in its kidneys, liver, bones, and blood—tissues and fluids that most people do not often eat. Produce grown in soil with elevated metals contamination may accumulate certain metals, especially lead and cadmium. Many traditional resources in the flood plain are subject to contamination.

Ambient Air

The ambient air concentrations of particulate matter contamination in CdA River Basin site have changed considerably over the last 30 years. Concentrations of sulfur dioxide and lead often exceeded EPA's air quality standards in the 1970s. Concentrations of cadmium also exceeded screening values during that time period. In 1980, ash from Mount Saint Helens in Washington contributed to the poor air quality detected at the time. These levels greatly diminished after 1981, when many industrial activities ended. Currently air quality in the site vicinity is within EPA's air quality standards and ATSDR screening values.

C. Completed Exposure Pathways

ATSDR has identified several completed exposure pathways for the CdA River Basin site. Of these **ingestion of surface soils and household dust by adults and children** is the most likely way people would be exposed to metals contamination at this site. These exposures may be divided as follows:

- Ingestion of residential surface soil and household dust by adults and children

    Incidental ingestion of residential surface soil and household dust is a completed past, current, and future exposure pathway.

    Contaminated soils and fugitive dusts are found in some residences. Some of the children who lived on the site have had documented blood lead levels in excess of 10 micrograms of lead per deciliter of blood (µg/dL).

- Ingestion of soils outside residential areas by adults and children

    Incidental ingestion of surface soils outside of the residential areas (i.e., in CUAs) is a completed past, current, and future exposure pathway. This pathway is particularly relevant for area residents who have additional exposures (e.g., at home).

Other Completed Pathways

Additional completed pathways include

- Ingestion of lead-based paint dust (from residences);
- Ingestion of groundwater and surface water used as potable sources;
- Ingestion of biota;
- Inhalation of airborne contaminants (in the past);

- Direct contact with contamination during maintenance activities; and
- Incidental ingestion and direct contact with CUA surface water and sediments.

D. Potential Exposure Pathways

ATSDR identified ingestion or direct contact with surface water and sediments from the flood plains, drainage ditches, creeks, streams, Lake CdA, and rivers as potential exposure pathways for the CdA River Basin site.

E. Potential Health Effects

Sampling data suggest that lead levels in some media may lead to blood lead levels in children above 10 micrograms per deciliter (µg/dL). Blood lead levels generally rise three to seven micrograms per deciliter for each increase of 1,000 ppm of lead in soil or dusts (CDC 1991, EPA 1986, Bornschein et al. 1986, ATSDR 1988).

The Centers for Disease Control and Prevention (CDC) has established a blood lead level of 10 µg/dL as a level of concern. Recent studies suggest that adverse health effects may occur in young children at even lower blood lead concentrations. Not all children, however, will be affected. These measurements show trends in large groups of people. They do not necessarily indicate results for an individual. A person who has one or even several blood tests with results over 10 µg/dL may not experience an adverse health effect at all (ATSDR 1999a).

Of the children tested in 1990, 37% had blood-lead levels over 10 µg lead/dL of blood. Of the children tested in 2002, that percentage had dropped to 2%. This drop may be the result of several factors, and the summary statistics alone do not allow ATSDR to determine precisely whether the drop in blood-lead levels stems from remedial or educational efforts, a combination of both, or from some other factor. During summer 2003, nearly 7% of the 75 children tested had blood-lead levels ≥10 µg/dL. Thus ATSDR believes that there may be other children residing within the CdA River Basin with elevated blood lead levels that have not been tested.

F. Conclusions

CdA River Basin site is part of a large and complex “Superfund” site. Mining and associated mineral processing activities have resulted in wide-spread contamination. The principal contaminant of concern for human health impacts is lead, but arsenic, cadmium, and mercury (in fish tissue) are also present at levels that warrant consideration.

Metal contamination varies in nature and severity from location to location. Thus, the specific public health hazards posed by these contaminants also vary from location to location and by the nature of use of the contaminated resources. Persons who use contaminated resources as part of a subsistence lifestyle (worst case scenario) are at greatest risk of adverse public health impacts.

Following is a summary of the ATSDR's *general* conclusions regarding the public health hazards associated with the major locations and situations for the site. They are based on an evaluation of available site information and sampling data.

Since the following conclusions are general, they may not adequately address the specific types of contamination present at all locations within the CdA River Basin site. Remedial activities for CdA River Basin site may call for more focused, situation-specific evaluations as needed.

Current Exposures

Biota in Lake Coeur d'Alene currently represent a public health hazard because of the concentration of lead and other metals found in fish taken from the lake. These elevated levels lead to the issuance of a fish consumption advisory by the Coeur d'Alene Tribe and the Idaho Department of Health.

Sections of the CdA River Basin site east of the eastern shore of Lake Coeur d'Alene are currently a public health hazard to area residents because:

- High levels of lead and other metals exist in surface soil, household dusts, and fish;
- Possible long-term exposure to contaminants in a variety of media; and
- Site conditions have resulted in elevated blood lead levels in some children.

Data from those populated areas within the state of Idaho, west of Lake Coeur d'Alene, however, indicate exposures in those areas currently pose no apparent public health hazard.

Some sediments along the Spokane River (within Washington State) pose a public health hazard. Preliminary results indicate that the potential for direct human contact with lead contaminated sediments through recreational and other types of activities exists along the shoreline at River Road 95 common use area (CUA) of the Spokane River. The results support the use of health advisory signs along portions of the Spokane River, as well as remedial efforts set by the U.S. EPA and the Washington Department of Ecology in order to reduce or eliminate the contamination for local and non-local residents who visit the shoreline and beach CUAs for recreational purposes.

Exposures for Residents Who Live and Recreate in the Area

Although not all residences within the site are highly contaminated with lead and other metals, exposure to contaminants through household dusts and residential soils presents a completed exposure pathway.

Homes with young children, children with cognitive deficits/disabilities, or women of child-bearing age are of most concern.

In addition, residents who regularly eat fish from Lake Coeur d'Alene are likely being exposed to lead, arsenic, and other metals. Those who eat an average of 540 grams (1.2 pounds or 19 ounces) or more of fish per day ("subsistence level") *and* 1) who are also exposed to metals from other sources, and/or 2) who already have elevated blood lead levels are at greatest risk.

Persons who live in the CdA River Basin and who also recreate at CUAs are at risk of additional exposures and possible cumulative health effects. Therefore, people whose homes have elevated levels of contaminants in soil and dust—or who have other sources of exposure, such as consuming fish—should exercise caution when recreating at CUAs in the CdA River Basin.

Potential for exposure to metals while recreating on the TCdA is generally low. However, persons who are potentially exposed to metals in their normal living environment should stay on the trail to reduce risk of additional exposure to contaminants in media in proximity to the trail.

Traditional subsistence tribal use is a desire of the CdA Tribe, however, given the current conditions within the CdA River Basin such a lifestyle will subject practitioners to unacceptable increased risk of adverse health impacts. Therefore traditional subsistence use of resources within the Basin are not advised because the risk presented by levels of contamination.

Exposures for Area Non-resident recreational users

ATSDR has also evaluated possible exposure to metals for CdA River Basin non-resident recreational users.

The data show that recreation at Lake Coeur d'Alene represents no apparent public health hazard. In arriving at this determination, ATSDR estimated exposure doses for acute and intermediate exposure durations for persons exposed to surface waters and sediments only during recreation. (e.g., water skiers, anglers). These estimated doses do not exceed levels known to cause adverse health effects. However large quantities of contamination reside at the bottom of the lake, and as conditions within the lake change, there is potential for these contaminants to mobilize and impact a variety of exposure pathways.

Warnings have been posted regarding metals contamination and precautions have been taken to reduce risk of exposure to metals in the vicinity of the TCdA. Non-resident recreational users who remain on the trail should not experience any increased adverse health effects from use of the TCdA. All users are advised to remain on the trail. If direct contact with contaminated soil does occur, the exposed area of the body should be washed.

Similarly for recreational users along the Spokane River, occasional, short-term exposures to metals in contaminated water represent **no apparent public health hazard**. However, eating fish or shellfish caught in some areas of the Spokane River **may**

represent a public health hazard because these fish may contain polychlorinated biphenyls (PCBs). This hazard especially pertains to children, pregnant women, and women who are considering pregnancy. Although this contamination is not thought to be related to mining wastes, the State of Washington has issued a fish consumption advisory for fish caught in the Spokane River (WDOE 1995).

Historical (Past) Exposures

Exposure to ambient air near CdA River Basin site smelter operations posed a **public health hazard** in the past because of elevated levels of particulate matter and sulfur dioxide. Currently, however, EPA reports that the site is in compliance with air standards.

The maximum concentration of lead detected in a groundwater sample taken from an Osburn residence in 1994 represented a **public health hazard**. Today, the area uses an alternative water source.

Future Exposures

Most of the surface soil and subsurface soil that has not been cleaned (remediated) remains contaminated with metals from past mining and smelting operations. In areas developed for human use (e.g., residential neighborhoods), prolonged exposure to contaminants could pose a public health hazard.

G. Recommendations

ATSDR makes the following recommendations for the CdA River Basin site:

Continue to test surface soils and household dusts throughout CdA River Basin site, to characterize more fully the extent of contamination. Priority should be given to residences where highly vulnerable populations such as children and pregnant women live.
Continue to remediate or cover contaminated soil in children’s play areas at residences and CUAs.
Remediate contaminated residential soils, especially in homes with highly vulnerable populations such as children and pregnant women. Health education alone is not a viable long-term solution.
Continue to provide health education materials to residents and non-resident recreational users about the hazards of lead ingestion. This material should include instruction on avoidance of these hazards and hygienic methods to prevent or reduce additional exposures.
Extend the existing Bunker Hill Institutional Controls Program to include the CdA River Basin site.
Continue to make blood lead monitoring available for area children. Perform follow up as appropriate.

Follow the fish consumption advisory for Lake Coeur d'Alene which was jointly issued by the Coeur d'Alene Tribe and the State of Idaho.
Take actions to decrease/eliminate contamination in the wild foods traditionally gathered by subsistence users.
Increase the number of warning signs along the Trail of the Coeur d'Alenes and restrict access to areas with elevated metals contamination.
Use dust suppression techniques to minimize dust release during remediation or construction activities.
The current sediment contact health advisory for the Spokane River (Washington State) should remain in place for the affected CUA. The advisory should recommend simple ways to limit contact with contaminated sediments at the River Road 95 CUA.
Eliminate or limit exposure to contaminated sediments for local and non-local residents who visit the shoreline and beach CUAs of the Spokane River for recreational purposes.
Review new site data as they become available to determine the possible health implications.

H. Public Health Action Plan

Activities Completed

To date, ATSDR staff have completed the following for the CdA River Basin site:

- Conducted public availability sessions within the CdA River Basin site to gather the communities' health-related concerns.
- Met with various community leaders.
- Attended various public sessions conducted by EPA.
- Attended meetings with groups organized to address environmental problems within the site.
- Published several health consultations on the site.
- Funded an environmental health exposure assessment.
- Funded blood-lead testing and intervention activities until fiscal year 2004.

Activities Ongoing and Planned

ATSDR will now or will in the future, if requested:

- Further assess the impact of site contamination on area Native American tribes;
- Evaluate additional relevant site data to determine, if possible, what long-term public health consequences could be connected to site-related contaminants;
- Work with CdA River Basin community to identify any additional environmental health concerns related to the site;
- Deliver health education programs, activities, and materials based on the communities' information needs;

- Assist other federal, state, and local public health agencies in developing health education programs, activities, and materials.
- Continue to cooperate with the state and local health departments as needed to review relevant health outcome data to address community health concerns.
- Coordinate with CDC's National Center for Environmental Health in helping the Basin Environmental Project Improvement Commission, the Idaho Department of Environmental Quality, the Idaho Division of Health, the Panhandle Health District, and EPA to plan an appropriate blood lead monitoring program for young children in high risk areas.

1. PURPOSE AND STATEMENT OF ISSUES

The Bunker Hill Mining and Metallurgical Complex was added to the National Priorities List (NPL) in 1983. The Agency for Toxic Substances and Disease Registry (ATSDR) has been involved with the Bunker Hill Superfund site and surrounding areas since the late 1980s, both to respond to community concerns and to fulfill the agency's congressional mandate of conducting public health assessments for all sites on the Environmental Protection Agency's (EPA) NPL.

During the late 1980s and early 1990s, ATSDR released a preliminary health assessment and several health consultations (ATSDR 2000c-2000e) that evaluated levels of environmental contamination at and near the former smelting and mining operation. For its first 5-year review (September 2000), EPA asked ATSDR to evaluate the effectiveness of remedial actions within the populated areas of the Bunker Hill Superfund site, a 21-square mile area also known as the Box.

Data and studies reviewed by ATSDR suggested that contamination and subsequent health effects within the Box appear to have been caused primarily by lead-laden air and smelter emissions. ATSDR released several health consultations to address those issues.

Current health concerns regarding contamination *outside* the Box principally stem from exposure to lead-contaminated household dust, surface soils, and possibly fish.

EPA has addressed areas in the Coeur d'Alene (CdA) River Basin extending from the Montana border westward to the Spokane arm of Lake Roosevelt in the State of Washington. This area, which does not include the Box, is now referred to as Bunker Hill Operable Unit 3 (Bunker Hill OU3) or the CdA River Basin site.

At the request of the Coeur d'Alene Tribe, in this document, ATSDR evaluated the possible consequences of living a modern subsistence lifestyle within the CdA River Basin. ATSDR provided a qualitative evaluation of the health consequences from exposure to surface soils, sediments, surface water, and biota using exposure factors and scenarios obtained from the Human Health Risk Assessment (HHRA) conducted in the CdA River Basin (TerraGraphics 2001) and data from the health consultation which evaluated metals in fish taken from Lake Coeur d'Alene (ATSDR 2003).

This PHA is a comprehensive review of available environmental sampling data and other site information on contamination levels in the CdA River Basin and the potential health impact on the community. It addresses past, present, and future public health concerns.

Data Collection and Compilation

In addition to summarizing findings of previous assessments and evaluations conducted by ATSDR on the CdA River Basin site, ATSDR received a large volume of data and information from local and state environmental and health agencies, as well as from EPA and its contractors. In this PHA, ATSDR strives to evaluate the likelihood of possible exposures to contaminants from former mining and smelter operations at the CdA River Basin site. ATSDR also evaluated whether possible exposures would have been or are now at levels that could be harmful to human health. This report includes data not previous considered in ATSDR's earlier site evaluations.

This document also addresses issues of particular concern to some area residents, specifically, the potential impact of exposure to lead on children living in and visiting the CdA River Basin and the potential impact of exposure to contaminants on people who use the TCdA for recreation. Data and summaries reviewed in making these determinations include the 1999 Engineering Evaluation/Cost Analysis for the Union Pacific Railroad Wallace-Mullan Branch and the Streamlined Risk Assessment included with it.

2. BACKGROUND

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal agency within the U.S. Department of Health and Human Services (DHHS). The agency is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct public health assessments of hazardous waste sites.

2.1 Site Description and History

The CdA River Basin site runs along the CdA River, through Lake CdA, and into the Spokane River. It is in a part of northern Idaho that has been mined extensively for lead, zinc, silver, and other metals. Much of the CdA River Basin within the state of Idaho is composed of rural and undeveloped land (Figure 1, Appendix A). Some of the metals contaminants have been transported via environmental media westward into Spokane and Stevens counties in the state of Washington.

According to the U.S. Environmental Protection Agency (EPA), industrial activities in the area date back more than 100 years. Mining in the area began in 1883, and smelting began as early as 1917. Since then, mining and smelting operations have released millions of tons of metals-enriched waste into the environment. These releases include air emissions from smelters and other sources, liquid runoff from mines, effluents from industrial facilities, and solid wastes largely in the form of ore wastes or "tailings", including those resulting from spillage of concentrated waste during transportation via railcar.

Once released into the environment the metals in these wastes have gradually dispersed through the atmosphere and water. They are now distributed over a wide area. Until 1968, tailings were often discharged directly into the South Fork of the Coeur d'Alene River or its tributaries. Since that time, they have been impounded or placed back into the mines (TerraGraphics 2000a).

Transport of contaminants from hillsides and tailings piles under the force of river flow and erosion, particularly during flood events, has also contributed to CdA River Basin contamination. The closure of most smelting operations in the Bunker Hill area in the 1980s diminished air emissions of metals considerably. Nevertheless, surface waters continue to carry tailings, contaminated sediments, and dissolved metals to areas west of the Box. As a result, virtually all soils located in the floodplain of the South Fork CdA River and CdA River are potentially contaminated. However, the concentrations of these contaminants, in most locations, are not at levels which could represent a human health threat. The bed sediments and some aquatic biota species of Lake CdA are also contaminated by metals. The contaminants could reenter the water column under the right conditions. Also bottom feeding biota could ingest the contaminated sediments and concentrate the contaminants within their bodies.

To communicate our findings more effectively, ATSDR has divided the site into two main areas (See Figures 1, 2, and 3):

- Areas east of the Box—Includes the South Fork CdA River upstream from the Box and the numerous drainage basins of the many tributaries flowing into this reach of the river. For surface soil sampling events, ATSDR defines this area as the drainage basin of the South Fork CdA River at locations upstream from the town of Osburn, Idaho. It includes the towns of Wallace, Silverton, Mullan, and Burke/Nine Mile.

- Areas west of the Box—Includes the drainage basin for Pine Creek and the region surrounding the confluence (near Kingston, Idaho) of the North Fork CdA River (which is actually north of the Box) and South Fork CdA River (downstream of the Box), tributaries flowing into the South Fork CdA River at the Box, Lake Coeur d'Alene and the entire length of the CdA River. It also includes the towns of Kingston and Harrison, the area known as the "Lower Basin," and the lateral lakes along the CdA River, roughly from the towns of Cataldo to Harrison. These lakes include, but are not limited to, Anderson Lake, Blue Lake, Black Lake, Swan Lake, Cave Lake, Medicine Lake, Killarney Lake, Bull Run Lake, and Rose Lake.

This PHA also discusses the Spokane River and the Trail of the Coeur d'Alenes (TCdA) including the segment from Harrison to Chatcolet. The area of the Spokane River reviewed covers river segments within the State of Idaho westward to the Spokane arm of Lake Roosevelt in the State of Washington (Figure 4).

Most activities that occurred within the Box are mentioned in this document only as necessary for comparison with activities occurring outside the Box. The Box area has been evaluated in previous ATSDR documents (ATSDR 2000c-2000e). Remedial activities in these areas are well underway.[1]

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[1] Reports suggest that remediation of residential areas within the Box have resulted in significant decreases in soil lead concentrations, indoor dusts, and child blood lead levels. Once the few remaining residential properties have been cleaned and remaining infrastructure issues resolved, the Institutional Controls Program (ICP) will ensure that barriers remain effective. Then residents, homeowners, businesses, and prospective developers can be assured that exposure to lead in residential surface soils within the Box do not pose a public health hazard. However, it should be noted that some homeowners have refused to have their property tested and remediated. As a result, there continues to be some risk and potential for further spread of contamination despite the cleanup and the institutional controls.

The ICP is a locally enforced set of rules and regulations designed to ensure the integrity of clean soil and other protective barriers placed over contaminants remaining throughout the Box. It is managed by the Panhandle Health District (PHD). The ICP provides education, sampling assistance, clean soil for small projects, pickup of soil removed from small projects, and a permanent disposal site for contaminated soils generated site-wide. It regulates and provides assistance with construction and renovation projects on building interiors. Such assistance includes ceiling and attic work, insulation removal, and work in dirt basements and crawl spaces. The fundamental purpose of the ICP is to protect the public health and assist local land transactions within the Box.

Areas such as those that are not affected by contamination from mining are not evaluated or discussed in this public health assessment.

2.2 Site Visits

ATSDR has visited the CdA River Basin site many times over the past several years, including visits to both the upper CdA River Basin (Mullan, Wallace, Silverton, Osburn, and Burke Canyon and elsewhere) and the lower CdA River Basin (Cataldo, Rose Lake, Harrison, the lateral lakes, and elsewhere).

In addition, ATSDR staff have taken a walking tour of the TCdA and visited common use areas (CUAs) along the CdA River, lateral lakes, Lake Coeur d'Alene, and the Spokane River. ATSDR has also met with local, state, and federal officials responsible for various aspects of site characterization and remediation on multiple occasions.

In 2000 ATSDR conducted public availability sessions within selected communities. The aim of having these meetings was to gather the public's health concerns related to the site. For the same reason, ATSDR staff have attended numerous meetings conducted by EPA. ATSDR staff have met with local elected officials, representative of the CdA Tribe, and with various community groups to learn local perspectives on conditions and on the site-related health-related concerns.

2.3 Demographics, Land Use, and Natural Resource Use

To understand the size, characteristics, location, and any unique vulnerabilities of on-site residents, ATSDR studied available demographics, land use, and natural resources use information.

2.3.1. Demographics

Most people who live within the CdA River Basin reside in the towns of Coeur d'Alene and Post Falls, Idaho. In general, the CdA River Basin is sparsely populated.

Approximately 6,000 of site residents live to the east of the Box (Figure 2). About 10,000 persons reside to the west of "the Box" not including the cities of Post Falls and Coeur d'Alene (Figure 3). Children three years of age or younger comprise 4% of the population outside of these major urban areas. Women of child-bearing age comprise 20% of the population residing outside of the previously mentioned urban areas.

U.S. Census data show that approximately 151,000 persons reside within 1 mile of the Spokane River as it runs between Coeur d'Alene, Idaho, to Lake Roosevelt in Washington (Figure 4). A majority of them reside in Coeur d'Alene and Post Falls, Idaho (Figure 5) as well as in Spokane Washington. Children three years of age or younger comprise 7% of the population, and women of child-bearing age comprise 47%.

2.3.2. Land Use

The majority of the CdA River Basin within Idaho remains undeveloped. Residential and commercial development is largely concentrated in the valley floor and canyons. A large part of Shoshone County (75%) and Kootenai County (32%) is federally managed land (i.e., national forests) (IPNF 1998). Another section of the CdA River Basin is Tribal land. A lack of roads and difficult terrain makes many areas difficult to access by car or truck. Access to these areas is available, however, through the TCdA, the river, trails, and dirt roads. The TCdA parallels the entire length of the CdA River. It also follows part of the southern shore of Lake Coeur d'Alene.

Land use within the CdA River Basin includes residential, recreational, agricultural, and light industrial. Approximately 31,000 persons reside in the larger cities of Coeur d'Alene and Post Falls in the state of Idaho. Spokane, the second largest city in the state of Washington, has a population of about 200,000 persons. Most other towns in the CdA River Basin have less than 2,000 residents each. Hunting, fishing, riding off-road vehicles, and hiking are popular recreational activities given that most of the land is rural and forested.

2.3.3. Natural Resource Use

Areas east of Lake Coeur d'Alene use groundwater and surface water as drinking water sources. Nearly 60% of the CdA River Basin population gets water from public water sources. These are usually people residing in the larger communities located in the valley. Others receive their water from private wells, springs, surface water, and other sources. Although groundwater contamination occurs throughout the site, an insufficient number of monitoring wells have been installed to characterize the nature and extent of contamination fully (TerraGraphics 2000a). As of 2001, 12 homes with contaminated private wells had been connected to municipal water, and five had received end-of-tap water treatment (TerraGraphics 2000a).

Lake CdA and the Spokane River are significant sources of recharge of the Spokane-Rathdrum Prairie. The Spokane-Rathdrum Prairie Aquifer is the sole-source aquifer which provides drinking water for over 500,000 people in the region.

Most of the larger water bodies—including the CdA River, the lateral lakes, Lake Coeur d'Alene, the Spokane River, and Lake Spokane—are used for recreation. The discharge from Lake Coeur d'Alene, a natural lake, forms the Spokane River (TerraGraphics 2000a). Recreational activities include fishing, swimming, wading, and boating.

The Coeur d'Alene Tribe resides outside of major cities and depends on natural resources including Lake Coeur d'Alene, the CdA River, and the surrounding lateral lakes. In the past the Tribe was highly dependent on Lake Coeur d'Alene and its surrounding waters. These former interactions would have resulted in increased exposure to site contaminants and would have likely resulted in adverse health effects, if levels of contaminants were at or above the concentrations found today. The traditional subsistence lifestyle is explained in detail in the Human Health Risk Assessment (HHRA). Currently the natural resources to which the Tribe would most likely exposed if living a modern subsistence lifestyle are fish from Lake Coeur d'Alene and wild plants (including water potatoes). ATSDR stresses that living a current subsistence lifestyle, given the current contamination within the CdA River Basin, would place Tribal members at increased risk for adverse health effects until remediation is appropriately affected.

3. ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

The CdA River Basin has been the subject of many site investigations and environmental studies. ATSDR evaluated data from some of these documents to determine which contaminants could be of potential concern.[2] ATSDR selected contaminants for further evaluation if the contaminant exceeded screening values[3] or normal background levels (Appendix C).

Two important points about screening values are of note. The first is that screening values are, by design, conservative (i.e., low) and non-site-specific. Thus they are "protective" of most probable exposures[4]. Their intended use is only to "screen out" those contaminants that need no further evaluation. They do not represent clean-up levels.

The second is that a contaminant's listing in a table means neither that a) exposure to that contaminant or adverse health effects have occurred, nor that b) ATSDR expects exposures or effects to occur. Inclusion in the tables indicates only that the PHA will evaluate and discuss the *potential* for exposures and adverse health effects for that contaminant.

3.1 Site Investigations

ATSDR found eight chemicals of potential concern in household dust, residential surface soil, non-residential surface soil, and other environmental media. These chemicals are aluminum, antimony, arsenic, cadmium, iron, lead, manganese, and zinc. ATSDR also found that lead, arsenic, and mercury are contaminants of potential concern in some fish species in Lake CdA. ATSDR 2003 reviews the samples in detail (See appendix I). ATSDR believes that the contaminant of greatest concern for this site is lead.

3.1.1. Surface Soils and Household Dust

ATSDR's analysis focused primarily on characterizing the contamination residents are most likely to contact. Contaminants from mining sites and smelters in the Silver Valley region, especially metals, are present in soils throughout the CdA River Basin. This contamination has moved through air and water sediment. Individuals and businesses have also often used mine tailings as fill material throughout the area, so these tailings also contribute to contamination.

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[2] For a more detailed review of investigations/studies, see Appendix B. All data tables are located in Appendix C.
[3] Screening values are health-based estimates of concentrations in environmental media below which no known or anticipated adverse health effects should occur. The values allow an adequate margin of safety except in the case of lead since typical public health concerns regarding lead health effects do not incorporate safety values.
[4] Most screening values, including MRLs, are not protective for an individual who is immunologically sensitized to the challenge agent.

The surface soil sampling locations can be split into four general categories:

1. Residential surface soils (Appendix C, Tables 1 and 2);
2. Surface soils at educational institution property (e.g., schools and daycares) (Tables 3 and 4);
3. Areas frequented by the public (common-use areas, or "CUAs"), such as beaches, campgrounds, boat launches, and parks (Tables 5 and 6);
4. Areas not frequented by the public—i.e., areas where exposures are less likely (e.g., mining sites, tailings piles, landfills, and waste dumps) (Tables 7 and 8).

The following metals have some surface soil concentrations throughout the CdA River Basin, that are higher than their screening values: aluminum, antimony, arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, silver, vanadium, and zinc. At several locations, however, only seven of these metals exceeded screening values significantly: antimony, arsenic, cadmium, lead, manganese, mercury, and zinc. Soils close to mining sites and in areas often submerged during flooding appeared to have the highest levels of contamination.

3.1.1.1. Residential Surface Soil and Household Dust

ATSDR reviewed more than 2,500 sampling records for surface soils and household dust collected 1996 through March 2000. The highest concentrations of metals were detected east of the Box. The average concentrations of arsenic, cadmium, lead, and zinc frequently exceeded screening values.

Samples of surface soils and household dusts frequently detected lead concentrations over 400 parts per million (ppm), which exceeds EPA's screening level for lead in residential soil of 400 ppm. On the basis of modeling and bioavailability studies, EPA has chosen a tiered approach to soil cleanup of residential yard soils with lead concentrations between 700 ppm and 1,000 ppm lead. For those yards a barrier such as vegetation will be used. Residential yards with soil lead concentrations greater than 1,000 ppm will be remediated via removal of soils greater than 1,000 ppm followed by placement of a barrier. As previously noted, locations close to mining sites and in areas often submerged during flooding appeared to have the highest levels of contamination.

Based on existing information, there does not appear to be mining-related contamination in the residential and commercial areas of the cities of Coeur d'Alene, Harrison, and Post Falls; however, in the past concentrations of lead and zinc were detected in the soils and sediments of Harrison Beach. This contamination was remediated as part of a Union Pacific Railroad (UPRR) removal action (EPA 2002b).

To lessen exposure to lead in household dust, EPA will use synthetic cover or sand to cap crawl spaces. This will reduce the generation of dusts and the tracking of contaminated soils into the home. Health officials will also assist the homeowner via cleaning of accessible attics and basements. A vacuum loan program and a one-time interior cleaning of selected homes with subsequent monitoring are also being considered.

3.1.1.2. Surface Soil from Schools and Daycares

ATSDR also reviewed over 300 sampling records for surface soil samples collected from area schools and daycares between August 1999 and March 2000. The highest concentration of lead detected east of the Box was near 12,000 ppm in a sample collected from a Mullan play area. This area of contamination subsequently has been remediated. West of the Box, the highest concentration of lead in surface soil samples taken from schools and daycares was about 170 ppm. This sample came from an elementary school play area in Cataldo. Surface soil samples collected from an educational area in Coeur d'Alene—Rainey Hill near Medicine Lake, off Clark Creek Road—contained lead over 500 ppm. Areas of elevated metals contamination received priority remediation.

3.1.1.3. Surface Soil from Common Use Areas

The CUA sampling suggests that the lead contamination in surface soil is highest in areas east of Lake Coeur d'Alene. Lead concentrations higher than 1,000 ppm were most frequently reported for CUAs along the CdA River and South Fork CdA River; no lead concentrations higher than this level were observed in CUAs along Lake Coeur d'Alene itself. Formal recreational areas (e.g., picnic areas, boat ramps) with lead concentrations greater than 700 ppm are to be capped. Lead concentrations higher than 1,000 ppm occurred infrequently along the Spokane River. This pattern may indicate the actual contamination distribution, but it may also reflect the limited number of sampling locations.

Another potential limitation is the sheer size of the area. Characterizing the precise extent of surface soil contamination for a region as large as the CdA River Basin is unrealistic. Thus, while ATSDR has reviewed the results of thousands of surface soil samples, quite possibly some areas of elevated contamination have not yet been identified.

Nonetheless, the available data show that contamination is mostly limited to flood zones, some mining and milling sites, and areas where tailings were used as fill materials (TerraGraphics 2000a).

Based on information contained in EPA's Record of Decision dated September 2002, in the past elevated concentrations of lead and arsenic were found in soil and sediment samples from Harrison Beach. These media were remediated as part of a UPRR removal action.

3.1.2 Drinking Water and Groundwater

Residents of the CdA River Basin generally get their water from one of three sources:

- Public water systems (regulated under the Safe Drinking Water Act and the State of Idaho);
- Community water systems (regulated by the State of Idaho); and
- Non-regulated private sources.

Much of this water comes from groundwater and surface water (TerraGraphics 2001). A number of studies have evaluated the quality of area drinking water, including three EPA surveys. These surveys addressed, respectively, the following:

- 114 residential tap water samples analyzed for metals other than lead (61 from homes served by public water systems);
- 222 residential tap water samples analyzed for lead (all samples from homes with nonpublic water system sources); and
- 140 residential tap water samples analyzed for lead (some samples were taken from homes served by public water systems. This survey was conducted by TerraGraphics).

For some datasets, no documentation was available to determine whether samples came from public or private sources or whether the sample was a first-draw or flushed-line sample.

All of the community and non-transient, non-community systems in the valley monitor for metals (communication from EPA 2003). The only system that had a documented, confirmed problem is a system called Sunnyslope Subdivision near Osburn, which had high cadmium levels. The system was owned by Helca Mining until recently. The Central Shoshone County Water District (CSCWD) now runs this system.

Sunnyslope had a shallow well, the water from which the system diluted with water from the CSCWD to meet the standard. The system is now served totally from the CSCWD system, and the contaminated well has been disconnected.

A number of other systems use wells, both shallow and deep, but none have shown problems with metals. A few other systems get their water from high mountain streams away from mining contamination. The only metals that show up are lead and copper from corrosive water in the distribution system itself. This water, however, is treated to remove this contamination.

Sampling data (Tables C11 and C13) from select drinking water suppliers (Table C10) in northern Idaho suggest that in the past, testing occasionally detected elevated concentrations of arsenic, cadmium, lead, mercury, and zinc in drinking water systems. ATSDR's review of the locations and depths of the affected wells shows, however, that the elevated levels of these contaminants apparently are not caused by mining wastes associated with the CdA River Basin site. Only one supplier was found to have contamination levels consistently exceeding maximum contaminant levels, but that supplier closed in 2002 (Appendix B, subsection B.2.2).

The Bureau of Land Management (BLM) has a well at the Killarney Lake boat launch that provides drinking water for the site. The well is screened about 200 feet down. BLM tested the water for several years prior to making it available to the public and continues to test the water to ensure that it meets drinking water standards.

Drinking Water from Non-Regulated Sources

Approximately 43% of CdA River Basin residences obtain drinking water from private, unregulated sources. Several studies have examined levels of contamination in groundwater resources at various locations in the CdA River Basin. These groundwater projects were limited in scale, but in combination they provide a consistent account of trends in groundwater contamination in certain parts of the area.

East of Lake Coeur d'Alene, groundwater flows in alluvial deposits and underlying bedrock. The depth of alluvial deposits ranges from tens to hundreds of feet. All groundwater sampling studies identified to date characterize levels of contamination in the alluvial deposits, but not in the underlying bedrock. The available data, therefore, are not representative of contamination in drinking water wells completed in bedrock.

Groundwater monitoring in the alluvial deposits of the CdA River Basin (Tables 9-11) has detected elevated levels of metals associated with mining wastes. Water downgradient from tailings piles, milling sites, and other sources of metals-enriched wastes showed the highest levels of contamination. Elevated metals concentrations, however, have also been detected in groundwater along the CdA River—a location far from mining sites. This finding suggests that groundwater in alluvial deposits containing tailings likely contain elevated levels of metals.

Several studies have found groundwater levels of metals to be higher than screening values for drinking water ingestion. Researchers measured these concentrations in alluvial deposits in the following areas: Canyon Creek, Moon Creek, Ninemile Creek, and Pine Creek drainage basins; the South Fork CdA River in the town of Osburn; Cataldo Mission Flats; and near Killarney Lake. Elevated concentrations of metals probably also occur in alluvial deposits of other locations in the area that have contaminated sediments, although further sampling in these deposits remains to be done.

The metals most frequently detected in CdA River Basin groundwater at concentrations exceeding their screening values are antimony, arsenic, cadmium, lead, manganese, and zinc. Other metals (chromium, copper, nickel, silver, sodium, and thallium) and nitrite also were detected at levels higher than screening values, but only in a small subset of the samples collected.

3.1.3. Surface Waters

Numerous studies have characterized levels of contamination in surface waters in the CdA River Basin (Tables 12-17). ATSDR's initial review of the sampling results identified some important trends that are reasonably consistent with the findings of most sampling efforts.

For instance, the studies show that metals are the contaminants detected most frequently in surface waters.[5] The extent of surface water contamination varies from location to location in the CdA River Basin, and has also varied from year to year.

Proximity to mining sites, river flow conditions, and many other factors affect the levels of contamination. Metals contamination in sediments throughout the region continues to be a source of surface water contamination, as demonstrated by the high surface water concentrations of metals detected when nearby sediments are disturbed. Elevated levels of many metals occur in surface waters near mine discharges (i.e., outfalls, seeps from tailings ponds, adits). Humans would not be likely to ingest these waters regularly, however, if at all.

Excluding the samples collected in CUAs, the metals most frequently detected above screening values in surface waters in the area are antimony, arsenic, cadmium, lead, and zinc. Elevated levels of arsenic are present throughout the CdA River Basin, even in areas not affected by the Silver Valley mining wastes. On the other hand, elevated levels of antimony, cadmium, lead, and zinc clearly vary throughout the region, with the highest levels found near mining sites. The lowest levels appear far downstream from the mining areas (e.g., in the Spokane River). In addition, chromium, manganese, mercury, and thallium occasionally appear above screening values, but only in a very small fraction of the samples.

During one incident in 1998, very high concentrations of many metals were detected after field personnel disturbed some metals-laden sediments, resuspending the metals. In response, surface water was sampled in many CUAs throughout the Basin. Several metals were present in many samples, and at concentrations many orders of magnitude higher than their corresponding screenings values. Long-term exposure to the water containing large amounts of resuspended sediments is unlikely, however, although acute exposures during recreational activities (e.g., incidental ingestion while swimming or wading) are possible.

Surface water contamination varies from location to location and from year to year in the CdA River Basin. As long as the sediments remain contaminated with metals, surface waters in the area will likely continue to be contaminated especially after sediments are disturbed and resuspended.

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[5] Polychlorinated biphenyls (PCBs) also have been detected in the Spokane River, but this contamination is believed not to originate from any Silver Valley mining wastes. The PCB's sources are probably more local.

3.1.4. Sediments

Over 75 million tons of contaminated sediments exist in Lake CdA (EPA 2002b). Migration of these sediments is likely to increase the concentrations of these metals downstream. Several studies have examined levels of metals contamination in CdA River Basin sediments in the deeper waters of Lake Coeur d'Alene (see figure 6). These contaminants could reenter the water column under the right conditions. Bottom feeding biota could ingest the contaminated sediments and concentrate them within their bodies. Others have reported how contamination levels vary with depth and still others have measured levels of contamination in shallow, near-shore areas frequented by people. These studies have often detected metals in area sediments (Tables 18-20).[6]

Elevated metals concentrations are present in surface sediments in areas ranging from the mining sites near the headwaters of the tributaries, to the South Fork CdA River, to downstream stretches of the Spokane River. In some areas, metals-contaminated sediments are several feet thick. Contamination from sediments will continue to move downstream as long as upstream sources of metals are present.

In all areas of the CdA River Basin concentrations of many metals exceed screening values[7] in at least one surface sediment sample collected. Levels of six metals, however, consistently exceed screening values and by a very high order of magnitude. These metals are antimony, arsenic, cadmium, lead, manganese, and zinc. In the Spokane River, the concentration of lead in sediments has resulted in the issuance of a sediment contact health advisory. Levels of aluminum and vanadium are also consistently elevated.

3.1.5. Aquatic Biota

Several studies have measured fish tissue contaminants in surface waters throughout the CdA River Basin. Although the individual studies have limitations, when viewed

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[6] PCBs have also been detected in the Spokane River sediments, but this contamination is believed to originate from local sources and not from Silver Valley mining wastes.
[7] To evaluate and compare sediment contamination, this PHA uses the same screening values as it does for soil ingestion.

These screening values stem from assumptions of lifetime exposures or intermediate and chronic exposures with soil ingestion rates characteristic of "pica behavior," that is, the behavior some children exhibit in habitually placing items in their mouths. Thus, the screening analysis in this document is extremely conservative because it is highly unlikely that people are exposed to sediments frequently or that people, even children, persistently engage in pica behavior with sediments.

Recent sampling in the CUAs of the CdA River Basin appears to provide a more realistic account of potential concentrations for exposures to contaminated sediments. These sampling results characterize levels of contamination in surface sediments in shallow water near recreation areas people are known to frequent. People are far more likely to come into contact with contaminants in these sediments as opposed to sediments far from shorelines and in deep water.

together the results reveal some consistent trends in the contamination levels. Metals found at elevated levels in the sediments also appear in the tissues of many fish and shellfish throughout the CdA River Basin. In addition, fish and shellfish in the Basin generally have higher levels of contamination than fish and shellfish in surface waters in northern Idaho not affected by the Silver Valley mining wastes.

Fish tissue contamination studies for the CdA River Basin completed to date report contamination in more than 1,000 fish samples. Although these sampling results are not sufficient for knowing precisely the contamination levels of all species that people eat, they suggest that metals concentrations in fillets (on a wet-weight basis) of all species sampled do not exceed 0.1 ppm for cadmium, 0.5 ppm for copper, 0.5 ppm for lead, 0.1 ppm for mercury, and 10 ppm for zinc. These values represent reasonable estimates of exposure concentrations for people who eat the fillets of CdA River Basin fish. They are also consistent with the large volume of data currently available.

ATSDR notes, however, that the estimates of contamination of CdA River Basin fish likely overstate metals concentrations in fish fillets, at least in some parts of the Basin, because the levels of metals contamination in fish vary depending on tissue type. Many studies on the CdA River Basin have found that levels of metals contamination in fish fillets are consistently lower than those in fish livers, kidneys, and other body parts that most people usually do not eat. ATSDR has been told that some members of the Coeur d'Alene Tribe traditionally cook/can and eat whole fish. The species of fish used was not indicated. ATSDR was also informed that many non-tribal residents can the entire fish.

Results from a number of sampling studies show that metals concentrations in whole fish in the Basin are much higher than in fillets. For instance, although the data are limited, several studies indicate that, in many species, concentrations of lead are much higher—by at least an order of magnitude—in the whole fish than in corresponding fillets.

The difference between these concentrations varies across species. Fewer whole fish samples have been analyzed for other metals, but the limited available data suggest that cadmium levels in various species of whole fish are up to 10 times higher than the upper range of values typically detected in fillets.

Few studies have characterized the levels of contamination in shellfish in the CdA River Basin (Johnson et. al. 1994, Johnson 1994 and 2000). The numbers of samples collected and analyzed in these studies, all conducted on crayfish in the Spokane River, are also extremely limited. The highest concentrations in whole crayfish observed to date are 41.0 ppm for zinc, 1.34 ppm for lead, and 0.44 ppm for cadmium. All concentrations are on a wet-weight basis.

To date, no statistically based study exists of fish tissue contamination levels for the entire CdA River Basin. Similarly, the nature and extent of metals contamination in shellfish has yet to be characterized fully by a statistically based study. Such sampling studies will provide greater insight into potential exposure concentrations proposed above.[8]

Fish Consumption Advisory

ATSDR and the Idaho Division of Health (IDH) reviewed data from a study conducted by the Coeur d'Alene Tribe and a collaborative interagency team. The analysis indicates that the concentrations of cadmium, lead, and mercury in gutted fish portions may pose a public health hazard to some people who live in the CdA River Basin. On the basis of these findings, a fish advisory has been issued for Lake Coeur d'Alene (see Appendix B.5.3 and the attached health consultation for a more detailed discussion).

3.1.6. Terrestrial Biota

Animals

ATSDR reviewed more than 15 studies (Table C32) that document metals contamination in wildlife in the CdA River Basin. No single study characterizes the nature and extent of contamination of wildlife throughout this area. Taken together, however, the results of many studies begin to paint a consistent picture. As expected, every reviewed study shows metals in the tissues of a wide variety of CdA River Basin animal species. Cadmium, lead, and zinc were detected most frequently. Other metals (e.g., arsenic, copper, and mercury) were also present, but less frequently.

The studies that collected samples both from the CdA River Basin and from uncontaminated areas consistently found levels of cadmium, lead, and zinc in the CdA River Basin animals to be significantly higher than levels measured from comparison samples. This trend suggests that the elevated contamination in CdA River Basin animals likely originated with mining wastes, which are distributed throughout the area. The reviewed studies generally focus on animals collected near Lake Coeur d'Alene, the CdA River and lateral lakes, the South Fork CdA River, and tributaries to the South Fork CdA River. No sampling data for areas along the Spokane River were identified.

Virtually every bird and mammal species sampled to date has metals contamination, but in tissues and fluids that most people do not consume frequently (e.g., its kidneys, liver, bones, and blood). Information on levels of contamination in muscle tissues from wildlife is very limited. The most extensive recent study of contamination in breast tissue of ducks suggests that cadmium and lead are rarely found at detectable levels in these tissues. When detected in the breast tissue, the metals were never found at levels over 0.1 ppm for cadmium, 1.6 ppm for lead.

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[8] Several studies also characterize PCB contamination levels in Spokane River fish. Total PCB contamination ranges from non-detects to nearly 3 ppm (on a wet-weight basis). This PCB contamination appears to be confined to the Spokane River Basin and apparently is not found in upstream areas (i.e., Lake Coeur d'Alene, the CdA River, and it's tributaries). Silver Valley mining wastes are not believed to be the source of PCB contamination in the Spokane River.

Other studies report comparable lead and cadmium contamination in a limited number of samples of duck muscle tissue. These limited data, however, do not adequately support a quantitative evaluation of human exposure to contaminants in all species of terrestrial wildlife.

Food consumption-related data suggest that only limited potential human exposures to contamination are likely. For instance, licenses in northern Idaho generally permit hunters to take just two large animals per year and up to 25 waterfowl per year (URS 1999). Therefore, hunting is limited and should contribute to limited food exposure. ATSDR notes that consumption is limited largely out of concern for known or suspected contamination. Additionally, a food consumption survey reported that 92 percent of selected tribe members and local fishers do not consume locally caught waterfowl (ATSDR 2000b).

Plants

Limited sampling data available suggest that home-grown produce in the CdA River Basin accumulates metals, especially cadmium and lead (IDHW 1976, URS 2000), from the soil in which they are grown. Metals contamination levels vary from location to location and from vegetable to vegetable. Furthermore, samples suggest that concentrations are higher for unwashed than washed produce (IDHW 1976).

In EPA sampling data, cadmium concentrations in the various types of produce ranged from 0.02 to 1.85 ppm, and lead levels ranged from 0.6 to 2.8 ppm. In contrast, sampling detected arsenic in roughly half the samples and never at levels greater than 0.11 ppm (URS 2000).

The CdA River Basin residents who eat water potatoes[9] reportedly harvest them only from the relatively uncontaminated areas of the St. Joe River Basin. Sampling data confirm that water potatoes in this basin have low levels of metals contamination. None of the 50 water potatoes samples contained lead or cadmium.

Water potatoes along the CdA River and the lateral lakes, however, contain elevated concentrations of several metals, especially in the "skins." The average concentrations of cadmium and lead in unskinned samples were for example, 0.39 and 30 ppm (wet-weight), respectively (Campbell 1999). Residents apparently do not frequently (if ever) consume water potatoes from the CdA River Basin, partly out of concern of the known contamination in the region. For those individuals who desire to return to the traditional subsistence lifestyle and consume foodstuffs grown within natural Basin resources, such

[9] Water potato (*Saggitaria latifolia*). In June the white-flowered, large, arrow-leafed water potato can be seen along lake and river shores. Once gathered, the water potato is prepared "like a regular potato"—baked or boiled, with its tail left on it. In the tail is "all the flavor." Source: Lewis & Clark rediscovery project. Available at: http://www.13-lewisandclark.com/ShowOneObject.asp? Site ID+50&ObjectID-601. Accessed February 5, 2003.

a lifestyle is currently unadvisable due to current levels of contamination within the Basin. The CdA Tribe has a moratorium on the use of plants within the CdA River corridor due to the levels of known metal contamination in the soils.

Though sampling data for the other wild plants that residents might consume, such as wild rice and berries, are extremely limited, the available data do confirm the presence of metals contamination in various species that grow in the area. Fully quantifying exposure for people who consume wild plants does not seem possible at this point, given the insufficient data available. For instance, although one survey reported that roughly 5% of residents (mostly tribal members and licensed fishers) consume locally-harvested wild rice once or more a week, the survey did not ask residents exactly where they obtain the wild rice.

3.1.7. Ambient Air

ATSDR identified several studies that measured levels of air pollution in and near the Box. The results of these studies illustrate how air quality at this site has improved since the early 1980s. Specifically, ambient air concentrations of particulate matter have changed considerably. Available data for the 1970s show that throughout the 21-square-mile Box, both maximum and average concentrations of total suspended particulates (TSP) exceeded EPA's then-current, health-based standard of 260 $\mu g/m^3$ and 75 $\mu g/m^3$, respectively (Table C37). During this same period, moreover, average or maximum concentrations of TSP exceeded EPA's then-current standards in Cataldo, Kingston, Mullan, Osburn, and Wallace (although the levels of particulate matter in these communities were considerably lower than those at Smelterville and other on-site communities).

In 1980, levels of particulate matter throughout the area continued to exceed EPA's air quality standards. According to ATSDR's contractors ash from the eruption of Mt. Saint Helens in Washington State contributed to much of the poor air quality detected during summer of that year. After many on-site industrial activities ceased in 1981, however, concentrations of particulate matter decreased throughout the area. In Osburn, for instance, airborne particulate matter concentrations reached potentially unhealthy levels just three times between 1981 and 1985, and they have not reached those levels since.

Concentrations of airborne lead also declined. During the late 1970s through 1981, air sampling detected lead in Cataldo, Kingston, Mullan, Osburn, and Wallace. Only in Osburn, however, did the measured lead levels exceed EPA's health-based standard. In 1981, however, the lead smelting facilities in the area stopped operating. No evidence since that time suggests that airborne levels of lead have reached potentially unhealthy levels outside the Box.[10,11]

[10] EPA currently classifies all of Shoshone County as being in compliance with the Agency's health-based air quality standard for lead.

Although most ambient air monitoring at the site has focused on particulate matter and lead, data were obtained for cadmium, copper, and zinc. Every ambient air concentration of copper and zinc that ATSDR reviewed, both from inside and outside the Box, was lower than corresponding screening values. This information suggests that airborne copper and zinc probably never reached levels of public health concern. However, it has been reported to ATSDR that dust devils occur during the summer and fall which could re-entrain contaminated dust particles.

All samples of ambient air exceeded the Cancer Risk Evaluation Guide (CREG) for cadmium, however. This fact reflects both the conservative nature of the CREG (0.0006 micrograms per cubic meter [µg/m^3]) and cadmium's elevated concentration near the Box. The maximum concentration of cadmium detected in ambient air in the past was less than the estimated daily intake of cadmium from smoking one packet of cigarettes per day (2-4 µg).

For sulfur dioxide concentrations, ATSDR reviewed data from what appears to be two distinct 1970s studies. Results of the first indicate that sulfur dioxide levels frequently exceeded EPA's health-based standard during the early 1970s. EPA's National Ambient Air Quality Standard (NAAQS) required that the annual average concentrations of sulfur dioxide be lower than 80 µg/m^3 and that 24-hour average concentrations be lower than 365 µg/m^3.

Results of the second study, which focused primarily outside the Box, showed that levels of sulfur dioxide in Cataldo, Osburn, and Wallace generally did not exceed EPA's health–based standard during the late 1970s. Only one of the 149 air samples collected in Osburn measured a sulfur dioxide concentration higher than EPA's health–based standard (Table C42a)[12].

3.2. Data Gaps

While reviewing available environmental sampling data, ATSDR noted several data gaps. These prevent a complete analysis of the following possible exposures:

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[11] Particulate matter concentrations were higher inside the Box than outside. Monitoring data from the 1980s and 1990s indicate that airborne particulate matter inside the Box periodically exceeded EPA's standards for most of the two decades.

Lead concentrations were also higher inside the Box than outside. Throughout much of the 1970s ambient air concentrations of lead at locations in the 21-square-mile Box exceeded EPA's quarterly-average standard (1.5 micrograms per cubic meter [µg/m^3]). At some Box locations, the annual average concentrations of lead exceeded EPA's standard by more than an order of magnitude.

[12] EPA reports all of Shoshone County as being in attainment of the Agency's health–based air quality standard for sulfur dioxide (TerraGraphics 2000a).

- Wells in the vicinity of the lateral lakes draw their water from the underlying bedrock, not from sedimentary layer above the bedrock; sampling data of the water from the fractured bedrock is needed to make an appropriate health call; and,
- There is evidence that some residents divert water from adits, ponds, and other water bodies for potable use.
- Information on Tribal subsistence and the use of natural resources within the CdA River Basin.
- Information on concentrations of contaminants in ambient air from blowing dust during the dry season or during remedial activities was not found.

4. EXPOSURE PATHWAYS ANALYSIS

This section summarizes the completed and potential exposure pathways associated with the CdA River Basin site. Among ATSDR's first goals during the PHA process is to identify exposure pathways. Exposure pathways are the different ways that contaminants move in the environment and the different ways that people could come into contact with those contaminants. In short, the purpose of the exposure pathway evaluation is to determine how, when, where, and whether anyone could come into contact with a contaminant in the past, present, or future.

This information alone does not define exposure, but it helps ATSDR to understand the likelihood of exposures. The exposure pathway information is used together with the environmental data to support the health effects evaluation.

ATSDR obtained information to support the exposure pathway analysis for the CdA River Basin site from multiple sources:

Site investigation reports;
Previously released ATSDR documents;
2000 U.S. Census data; and
Communications with local and state officials and community members.

The analysis also draws from environmental and exposure data, already present in this document for air, groundwater, soil and waste, biota, and surface water and sediment.[13]

To determine whether residents are exposed to mining related contaminants, ATSDR evaluated exposure pathways related to CdA River Basin site (Tables 43–45).

An "exposure pathway" is the way a contaminant moves from its source (where it began) to where people can come into contact with it. ATSDR regards an exposure pathway as complete" if all five of the following elements are present:

1. Source of contamination;
2. Environmental media and transport mechanism (e.g., air, water, animals);
3. Point of exposure (a place where human contact is possible);
4. Route of exposure (e.g., breathing, eating, touching); and
5. Receptor population (ATSDR 1992a).

An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. ATSDR categorizes exposure pathways that are not eliminated as either completed or potential. For completed pathways, all five elements exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential

[13] ATSDR recommends referring to relevant sections above, as well as to Appendices B and C, for detailed environmental data and medium–specific environmental transport information.

pathways, at least one of the five elements is missing, but could exist. For potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future. Tables C43-C45 in Appendix C summarize pathway information related to the CdA River Basin site.

4.1. Completed Exposure Pathways

The following details the completed exposure pathways for this site (see also Table C43).

4.1.1. Ingesting Household Dust and Surface Soils in Proximity to Residences by Adults and Children

Inadvertent ingestion of residential soil and household dust in some areas is a completed exposure pathway (past, current, future).

Contaminated soils and dust continue to enter some residences and inadvertent ingestion (that is, swallowing) of these materials by children and adults is the most significant exposure pathway at CdA River Basin site.

Exposure occurs when people have direct contact with soils. For instance, when children play outside or crawl on floors, or when adults work in yards and gardens, contaminated soil or dust particles can cling to their hands and be inadvertently swallowed when people eat, drink, or touch their mouths directly.

Exposures occur while people are in their homes as well because people and pets can track contaminated soils indoors. Household dust is an important route of exposure for young children (preschoolers) because they often play on the floor. In addition to spending time on the floor, very young children usually spend more time in the house than adults. Contaminated dust can get on their hands and be swallowed as they engage in normal hand-to-mouth activity.

While floor dust is important to consider, dust can be everywhere in the house: window sills, furniture, ducts, and elsewhere. In particular, because many people only occasionally clean them, window sills can become reservoirs for older, more highly contaminated dusts. This situation can be added to by another risk, the peeling of lead-based paints (if present) (TerraGraphics and URS 2001).

Factors affecting whether people have contact with contaminated soils and dusts include

> Vegetative cover—Vegetation reduces contact with contaminated soil when it is fairly dense, but contact with soil increases when vegetative cover is sparse or bare ground is present;
> Weather conditions—Certain conditions generally reduce contact with outside soil. For instance, during cold months, many people stay indoors more often, which may cause increased exposures to indoor dusts, which can be more important than direct contact with yard soils. Dry, dusty conditions outside may

also increase exposures. Wet weather conditions may result in increased tracking into homes of potentially contaminated soils which would be further increased when pets are going in and out.
Time spent outdoors—The amount of time someone spends outside playing or gardening;
Personal habits when outside—for instance, children whose play activities involve playing in the dirt are likely to have greater exposure than children who do not; and
Hygiene—both personal and housekeeping. Sweeping, vacuuming, or wet-mopping floors to keep dust levels low and ensuring children and adults wash their hands will help to reduce the amount of dust they ingest. Vacuuming should be done with a properly maintained HEPA filter as other vacuums may resuspend dust during the vacuuming process making the contaminated dust breathable. In addition, more frequent filter changes may be necessary.

Some residents will be exposed to contaminated soils and dust as long as they live in contaminated areas of the CdA River Basin unless remediation activities remove contaminants completely. Even then, recontamination of residential properties will remain a possibility. The presence of a strong institutional controls program, however, will help reduce the possibility of recontamination.

Ingestion of Lead

The main contaminant of concern for soil and dust ingestion at CdA River Basin site is lead. The blood lead level of some local children exceeds 10 µg/dL, a level that indicates probable exposure to lead.

In most cases, the greatest exposure to lead in soil occurs at home. Studies in the Box showed that neighborhood soil lead concentrations are highly correlated with lead concentrations in the indoor dust (ATSDR 2000a), and the same is likely true outside the Box. As noted above, preschool children have the highest potential for exposure. Children often engage in hand-to-mouth activity, which can result in the ingestion of soil that adheres to their fingers and hands. In addition, some children exhibit soil pica behavior, which is the recurrent ingestion of unusually large amounts of soil (1,000 to 5,000 mg a day).[14] (ATSDR 2001a).

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[14] Everyone ingests some soil or dust every day, and all children mouth or ingest nonfood items to some extent (ATSDR 2001a). When the activity is recurrent and the child intentionally consumes an unusually large amount of soil, the activity is known as “soil-pica behavior.”

In reference to increased soil intake, the degree of pica behavior varies widely in the population, and is influenced by nutritional status and the quality of care and supervision (ATSDR 2000a). Groups at increased risk for soil-pica behavior include children aged 1 to 3 years old and children of various ages with neurologic disorders (e.g., brain damage, epilepsy, and mental retardation) (ATSDR 1992a). Soil-pica behavior occurs as part of the normal exploratory behavior for some 1- and 2-year-old children and as part of an intentional behavior in older preschool children (3- to 6-years olds). Although it is most likely to occur in preschool children, it can also occur in older children and even in adults.

By comparison, adults and older children, even those who live in homes or visit houses with contaminated yards, probably have less exposure because they put their hands on or in their mouths less frequently than preschool children. Because older children tend to play in areas outside of their homes, however, they are more likely than young children to be exposed in areas other than home, such as CUAs, hillsides, tailings piles, and creek banks.

ATSDR observed that many area homes have yards with exposed soil and little grass cover. Children with soil-pica behavior who live in metals-contaminated properties could easily access contaminated soils in such yards. This hazard is most likely to occur during the warmer summer months, when preschool children are most likely to play outside. However, proper supervision and hygiene practices may mitigate or prevent many of these exposures. In addition, winter in this area is generally very cold, so soil-pica behavior is much less likely to result in exposures through soils during these months.

In addition to people with soil-pica behavior, some workers in the CdA River Basin may inadvertently come into contact with the contaminated soils. As an example, contractors and utility workers may work on job sites with contaminated soils. Exposure may occur if these workers get the soils on their hands and then inadvertently ingest soils when they touch their mouths (i.e., while eating, smoking, etc.).

Why some children engage in soil-pica behavior is not known. Some studies suggest that it has something to do with nutritional deficiencies, psychological needs, and cultural factors (Dansford 1982), but none of these links have been proven to be responsible for all soil-pica behavior. The exact number of children who engage in pica behavior is not known. Some studies have shown that this behavior occurs in as few as 4% of children; others suggest that the number is as high as 21% (Barltrop 1966, Robischon 1971, Shellshear 1975, Vermeer and Frate 1979). Another estimate is that up to 33% of children will have soil-pica behavior once or twice during their preschool years (Calabrese and Stanek 1998). The studies admit, however, that 33% could be an overestimate (Danford 1982, Calabrese and Stanek 1993, EPA 1997). The percentage of children at the CdA River Basin site with soil-pica behavior is unknown.

Studies on children have shown that soil-pica children eat varying amounts of soil ranging from 600 milligrams (mg) to 5,000 or more mgs per day (Calabrese and Stanek 1993, Stanek and Calabrese 2000, Calabrese et al. 1989, Wong 1988). Because of the limited number of such studies, some uncertainty exists in deciding what amount of soil intake should be used for soil-pica children. Therefore, for this PHA, ATSDR used point values for a range of soil intakes from 600 to 5,000 milligrams soil to estimate exposure for soil-pica behavior in children. Calculations were run separately for each. For further detail on methodology, please refer to ATSDR's public health consultation for Basin-wide Residential Properties Sampled Under Field Sampling Plan Addendum 06 (FSPA06), located in Appendix H.

It is reasonable to assume that soil-pica behavior might occur for several days in a row, or a child might skip days between eating soil (ATSDR 1992a, Calabrese and Stanek 1998, Calabrese and Stanek 1993, Wong 1988). In addition, general pica behavior is greatest in 1- and 2-year-old children and decreases as children age during their preschool years (Barltrop 1966).

Soil-pica Workshop

As part of the ATSDR's efforts to reduce the hazard of soil-pica behavior, we invited national experts to a soil-pica workshop on June 7 and 8, 2000. The purpose of the workshop was to seek advice about soil-pica behavior and to assist ATSDR in making public health decisions. The panelists reached the following key findings during the workshop:

Soil-pica behavior does exist.
The percentage of soil-pica behavior at given soil intake rates is poorly defined.
More research is necessary to understand the percentage of children with soil-pica behavior and the amount of soil which soil-pica children ingest; and
ATSDR should continue to use 5,000 mg per day as an estimate of soil intake for soil-pica children, even though very few studies are available.
ATSDR should continue to evaluate the public health significance of soil-pica behavior.

ATSDR considered the advice of the expert panel in evaluating the potential for soil-pica behavior at the CdA River Basin site. The advice and recommendations of the panelists are reported in Summary Report for the ATSDR Soil-pica Workshop (ATSDR 2001a).

4.1.2. Ingesting Soils during Recreation

Ingesting soils outside of the residence is a completed exposure pathway (past, current, future).

Residents and non-resident recreational users to the area can be exposed to metals in contaminated surface soils in recreation areas through ingestion of the contaminated soils. ATSDR considered a wide range of recreational activities, including hiking and camping, which might increase exposure to contaminants in soils.

4.1.3. Ingesting Lead-Based Paint

Although unrelated to Silver Valley mining activities, lead-based paint can be an important source of exposure to children living in some Basin residences. Peeling and flaking lead-based paint will result in small pieces which can be directly ingested or which can become a component of both exterior surface soil and interior house dust.

Properly maintained lead-based paint is not immediately hazardous. However, lead-based paint, especially surfaces subjected to friction (e.g., window and door frames) will eventually release lead through chalking, peeling or other deterioration. Care should be taken to maintain properly the paint in homes constructed prior to 1978. Also, regular physical examination of painted surfaces should be performed to identify early signs of deterioration.

4.1.4. Ingesting Groundwater and Surface Water Used as Potable Sources

A) Drinking groundwater and surface water is a completed past exposure pathway for the CdA River Basin site.

Past mining activities have resulted in lead and other metal constituents contaminating groundwater and surface waters. Within the Basin, groundwater and surface waters serve as sources of potable (suitable for drinking or cooking) water. Most water obtained from public and private community wells is regulated and is considered safe (TerraGraphics 2000a).

In 1994, however, testing of community wells for metals in Osburn Flats found that two of the four community wells and a middle school well contained cadmium at concentrations above screening values. The middle school well and one residential well also contained lead, and another community well contained zinc, all above screening values. Alternative potable water sources are being used (TerraGraphics and URS 2001), but in the past people were probably exposed to those contaminants in water from these wells through ingestion and direct contact.[15]

Residents who received their water from the Sunnyslope Subdivision's shallow well were probably exposed briefly to elevated levels of cadmium. In the past, the water was diluted with water from the Central Shoshone County Water District (CSCWD) to bring it into compliance. The contaminated well has since been disconnected, and the residents now receive their water from CSCWD. ATSDR is unable to determine whether the brief exposures would have resulted in adverse health effects because monitoring data are unavailable.

Some other water systems in the Basin have been shown to contain lead and copper from corrosion in the distribution system. Water systems are managing these contaminants with corrosion treatment.

B) Drinking groundwater and surface water in some CUAs is a completed past, current, and future exposure pathway for the CdA River Basin site.

Groundwater and surface water samples collected in CUAs have been shown to be contaminated with metals. ATSDR notes that much of the surface water sampling data reviewed for this PHA came from samples collected in a way not applicable to estimating

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[15] Lead may also leach into water through the plumbing system itself. For instance, lead used as solder on brass or copper pipes gradually dissolves in drinking water. As a result, people who drink water immediately from the tap rather than letting it run momentarily to flush out the system are more likely to be exposed because the first water drawn from the tap in the morning may contain higher levels of lead than water drawn later that day.

Similarly, grounding household electrical systems to plumbing can increase corrosion rates and thus leach lead into the system (Lee et al. 1989).

exposures resulting from drinking water ingestion. For example, many of the surface water samples were collected after the sediments had been disturbed.

The Bureau of Land Management (BLM) has a well at the Killarney Lake boat launch that provides drinking water for the site. The well is screened about 200 feet down. BLM tested the water for several years prior to making it available to the public and continues to test the water to ensure that it meets drinking water standards. A sample from the tap at the Killarney Lake boat launch in 1998 was contaminated with arsenic and zinc at concentrations above screening values. Whether the sample was a flush-line or immediate draw sample is not known.

Contaminant concentrations in other drinking water samples collected from CUAs were below drinking water standards. People ingesting water from non-regulated sources in CUAs could be exposed to metals through the water.

Shallow groundwater was also sampled. However, most people with wells draw their drinking water from fractured bedrock. The extent of groundwater contamination in the fractured bedrock, if any, is not known.

If people take groundwater from alluvial deposits for drinking water without treating it, they can be exposed to metals that may be in the water. The number of supply wells drawing from the alluvial deposits is unknown, but is thought to be limited.

4.1.5 Incidental Ingestion and Direct Contact with CUA Surface Water and Sediments

Residents and non-resident recreational users are likely being exposed to metals in contaminated surface water and sediments while swimming, wading, fishing, and conducting other recreational activities at CUAs, including rivers, Lake CdA, and the lateral lakes. Furthermore, some of the samples analyzed for this PHA came from places frequented by children. In this part of the country, water temperature tends to be too cold for swimming and wading a majority of the year. Therefore, ATSDR expects these types of exposures to occur intermittently during the summer season.

The Washington State Department of Health (WADOH) reviewed environmental data to determine whether contaminants found in beach sediments along the Spokane River pose a health hazard to the general public which uses the River for wading, swimming, picnicking, and other recreational activities. The River Road 95 CUA had the highest level of lead of 18 CUAs sampled along the river and was evaluated as a potential public health hazard.

Lead was found in beach and shoreline sediments at concentrations which exceeded EPA’s screening values and was investigated as a contaminant of potential concern at the River Road 95 CUA. Potential routes of exposure were determined to be ingestion, inhalation, and direct contact with contaminated sediments. Children represent the population at greatest risk for adverse health effects.

The concentration of lead in sediments along the Spokane River (Washington State) has resulted in the issuance of a sediment contact health advisory for sediments along the River Road 95 CUA.

4.1.6. Direct Contact with Contamination during Maintenance Activities

Workers who maintain the CUAs are probably being exposed through direct contact with contaminated soils and sediments. Although some remediation has taken place, these areas continue to be recontaminated as metals migrate from other areas (e.g., from upstream). Exposures are expected to be minimal, however.

Workers who maintain the TCdA are also at risk of exposure to contaminants in off-trail soils and tailings. The TCdA itself, however, has been completed in asphalt and probably will not be remediated.

All maintenance workers should receive hazard recognition and safety training to prevent taking contaminants home.

4.1.7. Ingesting Biota

Eating plants and animals from the CdA River Basin site represents a completed exposure pathway.

Sampling studies show that some biota in the area contain elevated concentrations of metals.

4.1.7.1. Ingesting Biota from Lake Coeur d'Alene

ATSDR's and IDH's review of a sampling study revealed that some fish from Lake Coeur d'Alene have elevated concentrations of lead, cadmium, mercury, and other metals. Persons who eat an average of 540 grams (19 ounces) or more of the contaminated fish per day are at increased risk for adverse health effects. Children, women of child-bearing age, and those persons with already-elevated blood-lead levels (usually from other exposures) are at greatest risk. As a result of the study findings, the State of Idaho and the Coeur d'Alene Tribe issued a fish consumption advisory for Lake Coeur d'Alene in June 2003.

4.1.7.2. Ingesting Biota from the CdA River Basin

People who eat locally caught fish especially whole fish and waterfowl, as well as water potatoes and other wild plants available in the CdA River Basin, are likely to be exposed to metals contamination.[16]

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[16] Metals are found in all biota, however the concentrations of the metals vary.

Members of the Coeur d'Alene Tribe who harvested water potatoes along the CdA River in the past were probably exposed to greater amounts of metals than they might be presently through this pathway.

4.1.8. Inhaling Contaminants from Ambient Air

Breathing contaminated outdoor air is a completed past exposure pathway for the CdA River Basin site.

Residents and non-resident recreational users (particularly in areas near the Box) probably were exposed to airborne particulate matter, sulfur dioxide, and metal contaminants from emissions from area mining activities. As noted above, most of the sampling data reviewed came from the Bunker Hill Superfund site Operable Units 1 and 2.

4.1.9. Multiple Exposure Pathways and Modern Subsistence

One or more of the above mentioned pathways could be complete for various people in the Basin. All pathways that apply to an individual, when combined, will contribute to that individual's overall potential exposure (See Table C45).

The routes of most concern at CdA River Basin site are

Ingestion of surface soil and household dust;
Ingestion of water from non-regulated sources; and
Ingestion of metals-contaminated biota.

Maximally exposed refers to those individuals who may be exposed to the selected contaminant in multiple media for an extended period of time. In short, this is a worst-case scenario. The maximum concentration of a contaminant in a particular medium is usually a "hotspot" and is not indicative of the entire area or medium being sampled

Average exposed refers to more moderate exposures of individuals exposed to the selected contaminant at varying concentrations. These exposures are generally of short duration (although exposure within residences may be an exception). The estimated exposure doses and possible adverse health effects associated with exposure to a contaminant can vary depending on the amount of time an individual was exposed to a contaminant (acute versus chronic exposure). These possible health effects are discussed in the Public Health Implications subsection (5) of this document.

In an earlier health consultation, ATSDR evaluated the effect of exposure through multiple pathways by examining data from 80 residential properties (ATSDR 2000a). While data from surface soil, indoor dust, and drinking water were evaluated, additional pathways—such as recreational activities, ingestion of fish and other biota, exposures at schools, daycares, CUAs, and lead-based paint—remain possible.

Additionally Tribal members who choose to live a modern subsistence lifestyle are likely being exposed to metals contamination in:

- surface soil via incidental ingestion and direct contact while engaging in subsistence activities on land;
- sediments via incidental ingestion and direct contact while engaging in subsistence activities in disturbed waters;
- surface waters via ingestion and incidental ingestion while engaging in subsistence activities in undisturbed surface waters; and
- biota including fish and wild plants such as water potatoes.

However, it should be noted that Tribal members are aware of the high levels of soil and sediment contamination within the CdA River Basin and therefore consumption of most wild plants harvested from within the Basin is limited. Consumption of whole fish and unpeeled water potatoes or other wild plants would increase the risk of exposure and adverse health effects in these individuals. The CdA Tribe has placed a moratorium on the use of plants within the CdA River corridor due to the high concentration of metals in the soils.

4.2. Potential (Possible) Exposure Pathways

The following discussions identify these pathways and the conditions missing from them (Table C44).

4.2.1. Ingesting or Touching Sediment and Surface Water

Rainwater and snow melt can carry contaminants from air and surface soil into local surface waters, such as drainage ditches, creeks, streams, and rivers. Some of the contaminants can then settle into sediments. People who play or work in these areas, in turn, can accidentally come into contact, or even swallow, small amounts of the contaminants in the water or sediments.

ATSDR recognized this potential route of exposure and therefore reviewed information on local sediments and surface waters. The data indicate that if people were to come into contact with CdA River Basin surface water in drainage ditches, streams, adits, or elsewhere, that contact alone would not result in significant exposure—unless, of course, people drank the water.

As this scenario seems highly unlikely, surface waters from non-CUAs are probably not an important route of exposure for people who live and visit the area.

Dermal contact is likely to result in only minimal exposure for these media. Nonetheless, people should avoid drinking the surface waters and avoid contact with the sediments. If a person comes into contact with contaminated media, the contact area should be washed as soon as possible

4.2.2. Direct Contact with Contamination during Remedial Activities

Workers conducting remedial activities will probably receive some form of safety training. They are also likely to wear personal protective equipment, which will provide an appropriate level of protection from contaminants in the sediments and subsurface soils. If they come into contact with contaminated media, workers should wash the contact area as soon as possible.

5. PUBLIC HEALTH IMPLICATIONS

5.1. Introduction

Health effects resulting from the interaction of an individual with a hazardous substance in the environment depend on several factors. One is the route of exposure, that is, whether the chemical is inhaled, ingested (swallowed), or touched by the skin (i.e., dermal contact). Other factors include how long the exposure occurs, the dose to which a person is exposed, and the amount of the substance that is actually absorbed. Mechanisms by which the environment or the body alters chemicals, as well as the combination of chemicals, are also important. Once exposure occurs, characteristics including a person's age, sex, nutritional status, genetics, lifestyle, and health status may influence how the body absorbs, distributes, metabolizes, and excretes contaminants.

Together, those factors and characteristics determine the health effects that could occur as a result of exposure to a contaminant. Much variation in those mechanisms exists among individuals. Because of the variation in mechanisms of exposure, ATSDR has made several assumptions to make a reasonable estimate of exposure levels for people in the CdA River Basin.

Background Information on Evaluating Soil Ingestion

Children have a range of soil intakes. Most preschool children have soil intake levels that range from 10 mg to over 200 mg each day. For instance, a typical child may have a daily intake for a week of 10 mg, 40 mg, 30 mg, 5 mg, 90 mg, 50 mg, and 20 mg, which averages to 35 mg a day. This intake probably results from daily hand-to-mouth activity. Some children will have a higher or lower daily average, but studies show that average daily soil intake for young children is somewhere between 100 and 200 mg (Stanek & Calabrese 2000).

For children with above average soil intakes, some will practice soil-pica behavior. The amount of soil ingested during a soil-pica episode varies, ranging from levels above 200 mg to 5,000 mg (one teaspoon) or more. A study of children living near a smelter site in Montana, for instance, found one child with a soil-pica intake of 600 mg (about ⅛ teaspoon). To estimate exposure from soil intake, ATSDR used a range of soil ingestion rates, 30–5000 mg of soil.

Another factor to consider for soil-pica behavior is the frequency of soil-pica episodes. To incorporate frequency, ATSDR assumed a one-time soil-pica episode and a 3-day soil-pica episode over a week or for several weeks. As a conservative measure, ATSDR used the maximum concentration of the contaminant found in soil samples for the area under consideration.

Health Guidelines

To determine whether harmful effects are possible, ATSDR first compared the estimated exposure doses to health guideline doses for exposures to the contaminant under consideration. The health guideline dose, or Minimal Risk Level (MRL), is an exposure level below which harmful health effects are not expected. If an ATSDR MRL is not available as a health guideline, then EPA's Reference Dose (RfD) or another appropriate health guideline is used. See appendix D for more information on how exposure doses are calculated and resulting estimates.[17]

ATSDR uses MRLs and other established health guidelines to rule out exposures that are too low to warrant further study because no health effects are expected. Put another way, when an exposure exceeds an MRL or other appropriate health guideline, it means that the dose is high enough to warrant additional evaluation. Exceeding an MRL or other health guideline does not mean, however, that ATSDR expects a harmful effect to occur. As noted, many other factors are involved.

If an estimated dose exceeds an MRL or other established health guideline, a more thorough evaluation is then performed to estimate risk of adverse health effects. This evaluation involves analysis of toxicological and epidemiological studies and may include the following:

Comparing the chemical concentration in soil to concentrations that cause harmful effects to determine how close the concentrations are;
Determining who is exposed and if they may be more sensitive to the chemical;
Considering exposure through multiple media;
Evaluating the location of the air sample in relation to where people actually live;
Determining whether the toxicological effect in the study is applicable to people who are exposed;
Considering different aspects of exposure in the study (e.g., dosing period, amount, frequency of exposure) and the applicability of those aspect to people who live at the site and their exposure;
Considering the effect of uncertainty in exposure estimates; and
Considering the effect of uncertainty in deciding possible harmful effects.

After conducting its site-specific toxicological evaluation, ATSDR determines the likelihood that people exposed to site contaminants will experience harmful effects from that exposure.

[17] MRLs refer only to *noncancer* health effects and cannot be used to determine cancer risk.

5.2. Discussion of Public Health Significance of Contaminants of Concern

Exposure to contaminants in residential, non-residential, and recreational area surface soils represent completed exposure pathways. Exposures to contaminants in groundwater, surface water, surface sediments, aquatic biota, and terrestrial biota, as well as through inhalation of contaminants in ambient air (in the past) also represent completed exposure pathways. Those exposures occurring due to mercury and other contaminants in aquatic biota are discussed in detail in ATSDR 2003 (see appendix I). Residential exposure to lead-contaminated household dusts is a completed pathway of primary concern for toddlers and children under two years of age. Those who reside in the CdA River Basin are likely being exposed at home and, along with non-resident recreational users, are probably being exposed while engaged in recreational activities.

In May 2000, ATSDR evaluated surface soil, indoor household dust, tap water, and surface water data at 80 CdA River Basin residences to determine if children aged 1–2 years might be at risk of elevated blood-lead levels (ATSDR 2000a). ATSDR used three methodologies:

Method 1 quantified risk through calculation of an estimated daily intake dose and by comparing it to an intake of concern (IOC) for the population for lead. The method was developed by the Ontario (Canada) Ministry of the Environment and Energy (MOEE 1994, 1996). The IOC of 1.85 µg Pb/kg/day is a daily intake resulting in greater than 95% of children exposed having blood-lead levels less than 10 µg/dL.

Method 2 used EPA’s Integrated Exposure Uptake and Biokinetic Model (IEUBK) for predicting lead exposures in children. This method calculates a complex set of equations to estimate the potential concentration of lead in the blood.

Method 3 estimates blood-lead levels using ATSDR’s integrated exposure regression analysis model (Abadin 1997, ATSDR 1999a). This approach uses slope values from selected studies that correlate environmental lead levels with blood-lead levels. It then integrates all exposures from various pathways, thus providing a cumulative exposure estimate expressed as total blood lead.

Using these methods, ATSDR estimated that between 22.5% and 79% of the 80 residential properties sampled have concentrations of lead high enough to result in blood-lead levels of 10 µg/dL or greater in children of 1–2 years of age. These methods were not used to predict blood-lead levels in residential properties in the Basin, and the differences in results between the methods highlight the difficulty in attempting to do so. Even the lowest estimate of risk indicates a significant risk of elevated blood lead exists for young children who could be exposed to high levels of lead in surface soils and household dusts at residential properties in the CdA River Basin. If children are exposed to lead through additional pathways as well, these risks will increase. This public health consultation was one of many documents reviewed in preparing this public health assessment. For more information on modeling and the methodologies used in the health consultation, please refer to Appendix E of this PHA and see Appendix I for link to the actual public health consultation.

5.2.1. Exposure to Lead

Environmental levels for lead-contaminated media at concentrations in which "no adverse health effect should occur" would be extremely low. The regulatory blood lead level of 10 µg/dL is not a biological threshold for adverse health effects (CDC 1991, NAS 1993, Cory-Slechta 2003). Recent studies have shown that the dose-response may be steeper for blood levels <10 µg/dL compared with those >10 µg/dL (Bellinger & Needleman 2003; Canfield, Henderson et al. 2003; Canfield, Kreher et al. 2003).

ATSDR evaluated whether CdA River Basin residents and non-resident recreational users were or are being exposed to lead in soils at levels associated with adverse health effects.

For cancer effects, the weight of evidence from numerous studies has yet to establish a clear link between lead and cancer. Given the vast amount of research on lead-related health effects, this lack of positive associations suggests that lead is a very weak carcinogen in humans, if it is a carcinogen at all. Therefore, exposures to lead in soils in the CdA River Basin probably are not associated with an increased risk of cancer.

Furthermore, health effects following non-occupational exposure and environmental exposures among adults generally are not serious.

Hand-to-mouth activity may, however, expose local residents and non-resident recreational users (especially infants and preschool children) to lead in soil. Some studies show that about 30% of blood lead in children comes directly from exposure to lead in soil (Manton, Angle et al., 2000). EPA's blood lead model also predicts that a significant portion of a child's blood lead comes from soil. Dust, particularly indoors, is another important source of lead exposure.

Researchers have found widely varying relationships between soil and dust lead levels and children's blood-lead levels. These levels have ranged from 2-16 µg/dL increase in blood lead per 1000 mg/kg of soil/dust lead concentration (ATSDR 1999a; Reagan and Silbergeld 1989). In part, this range is related to the bioavailability of the lead which, in turn, depends upon the physical and chemical characteristics[18] of the lead/soil matrix and the particular lead species (Mushak 1991). Studies measuring lead concentrations at various soil and dust particle sizes show that higher lead concentrations are often found in the smaller-sized fractions (Duggan and Inskip 1985). This fact is particularly important

[18] The physical and chemical characteristics of soil can vary between smelter, urban, and mining sites. Lead particles at mining sites are typically of larger size and consist of the less-soluble lead sulfides. As a result, lead particles at mining waste sites may be less bioavailable and therefore pose less of a human health hazard than lead found at smelter sites or in urban areas (Hemphill et al. 1991; Steele et al. 1990). Some studies suggest, however, that this may not always be the case and that a site-by-site evaluation is necessary to determine the lead hazards (Gulson et al. 1994; Mushak 1991). In addition, gastric juices have been shown to convert lead sulfide into the more soluble lead chloride (Healy et al. 1982).

for young children because smaller particles (<100 micrometers in diameter) also tend to adhere more readily to hands, and lead from smaller particles is more easily absorbed (Barltrop and Meek 1979). Other factors that affect the lead soil/dust-blood lead relationship include the population's varied nutritional status and behavioral factors, such as hand-to-mouth activity and pica.

Despite these many variables, the scientific literature over the past 20 years has demonstrated a clear association between soil/dust lead concentration and blood-lead levels. Recent studies continue to demonstrate this association (Lanphear et al. 1996, 1998; Malcoe et al. 2002; Yang et al. 2002, von Lindern et al. 2003b).

CDC reports that blood-lead levels generally rise 3 to 7 micrograms per deciliter (µg/dL) for each increase of 1,000 parts per million (ppm) of lead in soil or dust (CDC 1991; EPA 1986; Bornschein et al. 1986; ATSDR 1988). Others show a wider range of impact 2-16 µg/dL) as mentioned previously. The CDC has established a blood-lead level of 10 µg/dL (10 micrograms of lead per deciliter of blood) as a level of concern.

ATSDR's observations suggest that other sources of lead exist in the CdA River Basin in addition to soil and dust. These sources include water via plumbing/fixtures and lead-based paints. Older homes are not only more likely to have lead in plumbing, but are also more likely to have higher concentrations of lead in their paint. Unresurfaced housing built before 1950 poses the greatest risk for children being exposed to lead from paint (CDC 1985 and CDC 1991). In addition, children can also be exposed to lead through their diets, eating food from lead-laden ceramics, using certain traditional medical remedies, and from some parents' occupations (CDC 1985; CDC 1991).

Human epidemiological population studies demonstrate an association between low-level lead exposure and child development (ATSDR 1999a; CDC 1991; Canfield, Henderson et al., 2003; Canfield, Kreher et al., 2003; Cory-Slechta 2003; Lanphear, Dietrich & Berger 2003; Selevan, Rice et al., 2003; Wu, Buck & Mendola 2003). Blood lead levels over 10 µg/dL are associated with cognitive and neurobehavioral effects. Recent studies suggest that these effects could be observed at even lower blood-lead levels (Canfield, Henderson et al., 2003; Canfield, Kreher et al., 2003; Lanphear et al. 2000; Walkowiak et al. 1998). Many other effects begin at these low blood levels, including decreased stature or growth, decreased hearing, and decreased ability to maintain a steady posture. These effects become more pronounced at higher blood-lead levels. Lead's impairment of the synthesis of vitamin D is detectable at 10 to 15 µg/dL blood-lead levels.

Site-specific conditions, such as the amount of bare soil in children's play areas, the chemical form of the lead, how much lead crosses the gut, and particle size may also affect blood-lead levels and the possibility of harmful effects (ATSDR 1999a).

The chief concern at the CdA River Basin site is what contribution lead in soil makes to a child's blood-lead level already affected by other lead sources. Because children's play habits and hand-to-mouth activity vary, soil lead's contribution to a child's blood-lead level probably also varies. This variation makes it difficult to determine on a child-by-child basis precisely how much lead in soil is actually getting into the blood.[19]

Analyzing the relationship between blood lead data and residential soil lead locations would not be practical because:

- The blood lead data are collected through voluntary participation in a blood lead screening program compared to the systematic way that the soil lead data were obtained, which could introduce uncertainty into any analysis. Children whose parents chose to have them tested may have a significantly different chance of living at a location with elevated soil lead levels than those children whose parents chose not to have them tested. Therefore any analysis might not reflect the actual relationship between blood and soil lead levels.
- The relationship between blood and soil lead levels is more complex than what can be demonstrated through simple comparison of blood and soil lead levels at the same location (provided the information were made available). As indicated on page 262 of the ATSDR Toxicological Profile for Lead (ATSDR 1999a), "*The relationship depends on depth of the soil sampled, sampling methods, cleaniness of the home, age of the children, and mouthing activities, among other factors.*" In addition, the amount of soil contact that a child may have is likely to vary depending on season of the year. A reasonable way to address the problem is to collect data on lead levels in soil, blood, household dust, water, and other media at the same time, then analyze. Such an investigation is beyond the scope and purpose of a PHA.
- The results of such analyses would not change or help refine the recommendations and public health action plans proposed in this PHA.

ATSDR must evaluate soil-lead levels in a more general sense.

In some properties in the CdA River Basin site, the elevated lead levels in soil—along with associated lead in house dust and from other sources—increase the risk for elevated blood-lead levels in some preschool children. Population studies suggest that if a child's blood-lead level exceeds 10 µg/dL the following health effects may occur:

Neurobehavioral effects, such as decreased intelligence or delays in development;
Impaired growth (decreased stature);

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[19] EPA has designed its Integrated Exposure Uptake Biokinetic (IEUBK) model to predict the probability of elevated blood lead levels for children. The IEUBK model addresses the multimedia nature of exposure to lead, lead pharmacokinetics, and the variability in exposure and risk. As indicated above, ATSDR used three methods to estimate that between 22.5% and 79% of 80 residential properties sampled in the CdA River Basin in 1999 have concentrations of lead high enough to result in blood-lead levels of 10 µg/dL or greater in children of 0-2 years of age. Even the most conservative of the three methods indicated that a statistically significant risk of elevated blood lead exists for young children who might be exposed to high levels of lead in surface soils and household dust at residential properties in the CdA River Basin. Use of the intake of concern and IEUBK model resulted in a higher estimate of children with elevated blood lead levels than had been actually seen in the State's Exposure Assessment and annual blood lead screening in the Basin.

Endocrine effects, most commonly altered vitamin D metabolism;
Blood effects, such as changes in blood enzyme levels; and
Decreased performance on hearing tests.

Several population studies document these lead-related effects (e.g., CDC 1991; ATSDR 1999a). The effects are difficult to identify in an individual child because of the large inter-individual variability in cognitive function. However, adverse effects of lead are real and appear consistently in many population-based studies (CDC 1991; NAS 1993; Canfield, Henderson et al., 2003; Cory-Slechta 2003).

Several studies indicate that the increase in blood lead concentration as a function of soil lead concentration is not linear. That is, at higher soil lead concentrations, the rate of increase in blood lead levels is not as great (Shilling and Bain, 1989). According to this study, an increase in soil lead concentrations from 100 ppm to 1,000 ppm was linked to a change of the predicted blood lead level from 7.3 µg/dL to 13.0 µg/dL, an increase of 5.7 µg/dL. However a soil lead concentration of 2,100 ppm was linked to an estimated blood lead level of 15.2 µg/dL, a change of 2.2 µg/dL.

To determine the extent of lead impact in children and the effectiveness of current remedial activities, the Panhandle Health District (PHD) offers voluntary blood-lead testing at several locations in the CdA River Basin. This screening allows local health authorities the opportunity to detect and treat area children who could be adversely affected by area contamination. The program is totally voluntary and often includes monetary incentives. Children found to have blood leads exceeding 10 µg/dL receive a follow-up visit from a public health nurse who attempts to identify and remediate the source of the child’s exposure. Currently available information indicates that the number of children with high blood leads is decreasing. Opinions differ, however, regarding how representative the tested children are of all CdA River Basin children.

CDC guidelines recommend that when children have venous blood-lead levels of from 15 to 19 µg/dL, careful follow ups are warranted. A health care provider or appropriate health official should take a careful history to look for sources of lead exposure, and parents should receive guidance about interventions to reduce blood-lead levels (CDC 1991).

Although ATSDR did not receive enough quantitative data for a more thorough analysis for the CdA River Basin, population based studies show that long-term residential exposures, combined with possible recreational exposures, could contribute to subtle neurological and hematological changes in the potentially affected individuals, especially children. Highly susceptible populations, such as children and pregnant women, should avoid ingestion of contaminated fish and produce grown in contaminated soil. Meals prepared with whole fish will likely contain higher levels of lead than meals prepared with fish fillets.

The surface soils, sediments, surface water, and groundwater upstream and downstream of the Box have been shown to contain lead.[20] The lack of a clear threshold for health effects and the need to consider multi-media routes of exposure makes evaluating the risks from exposure to lead in the environment difficult. In addition, factors such as absorption potential of the lead compound of interest, and age and nutritional status of the population complicate the development of generic guidance. A majority of the studies ATSDR reviewed in preparation of this PHA attempted to correlate environmental concentrations of lead to blood lead levels. As stated previously, ATSDR did not receive sufficient data from sampling events to develop a correlation between environmental concentrations of lead and the estimated exposure dose in specific areas to the concentration of lead in the blood of individuals residing or recreating in those areas. In addition, such analyses would be impracticable for the reasons stated above.

Based on the estimated exposure doses, ATSDR believes that prolonged exposure to lead in the various media downstream of the Box could cause a person to develop hematological disorders. Lead has long been known to affect heme biosynthesis by affecting the activities of several enzymes in the heme biosynthetic pathway. Two experimental studies of the effects of oral exposure to lead on heme synthesis in humans were available. Two groups of five women and one group of five men who ingested lead acetate at 0.02 mg lead/kg/day every day for 21 days experienced decreases in erythrocyte aminoleuvulinic acid dehydratase (ALAD) by day 3 of lead ingestion (Stuik 1974). The decreases became maximal by day 14 and then remained constant through day 21. An increase in erythrocyte protoporphyrin (EP) occurred in the women, but not in the men, starting after 2 weeks of ingestion. Blood lead levels were approximately 15 µg/dL before exposure and increased to approximately 40 µg/dL during exposure. Increased EP was observed in five men at a higher dosage, 0.03 mg lead/kg/day (which produced a mean blood lead level of 46 µg/dL), starting after 2 weeks of lead ingestion (Stuik 1974). Similar results were reported by Cools et al. (1976) for 11 men ingesting lead acetate at an initial doseage of 0.03 mg lead/kg/day, which was decreased to 0.02 mg lead/kg/day or less as necessary to maintain a blood lead level of 40 µg/dL; the mean pre-exposure blood lead level was 17.2 µg/dL. All persons, especially children, should avoid prolonged contact with the contaminated media and use proper hygienic methods to avoid incidental ingestion of the contaminated media. ATSDR does not, however, expect an increased risk of cancer.

The sediments and surface waters of Thompson Lake and the Rainy Hill picnic area also contain elevated levels of lead. An individual would probably not, however, ingest enough of the water containing disturbed sediments to cause adverse health effects. The estimated exposure doses are nearly three orders of magnitude less than the cancer effect level found in animal studies (27 mg/kg/day (Azar et al. 1973)). Therefore, ATSDR does not expect an increased risk of cancer in the exposed populations.

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[20] The estimated combined exposure dose can cause a person to develop hematological disorders such as decreased aminoleuvulinic acid dehydratase (ALAD) activity, even when exposed only for a short time (acute). The estimated intermediate exposure dose is about an order of magnitude greater than the dose shown to cause decreased ALAD activity and increased red blood cell porphyrin in humans.

Lead was also detected in some surface water, sediments, and surface soils samples from the Lake Coeur d'Alene area (particularly those areas near the outlet of the CdA River) as well as in some tap water samples from Harrison Beach. Exposures to these media are expected to be of acute/intermediate duration, therefore adverse non-cancer health effects are unlikely to occur. Similarly, ATSDR does not expect an increased risk of cancer from these exposures. However, persons who have residential exposure in addition to recreational exposure should utilize caution and avoid prolonged contact with potentially contaminated media.

Those who use the Spokane River and its CUAs for recreational activities are likely to be exposed to various metals in various environmental media. The concentration of lead (average 1,410 mg/kg) has resulted in the issuance of the sediment contact health advisory. Elevation of the potential health consequences from exposure to the sediments suggests that the lead at the River Road 95 CUA is a public health hazard because young children who go to the site regularly have a significant chance of having elevated blood lead levels. An increased risk of cancer is unlikely.

On the basis of fish and shellfish samples from the Spokane River to date and relevant exposure estimates, ATSDR does not anticipate adverse health effects from metals contamination from the consumption of fish fillets from river fish caught west of the Upper River dam. ATSDR agrees with the State of Washington and does not recommend consumption of Spokane River fish caught east of Upper River dam. ATSDR does not recommend consumption of whole fish as lead concentrates in bone tissue. In addition, based upon currently available data, eating very large quantities of local crayfish could increase a person's overall body lead burden.

As stated throughout this report, persons at risk of multiple exposure sources for lead should try to eliminate as much exposure to lead as possible. This is especially true for children and pregnant women. Therefore, ATSDR believes that residents who must face multiple sources of metals exposure *should eliminate or drastically decrease their consumption of locally caught fish or shellfish*. Taking this precaution will reduce their chances of developing adverse health effects caused by the cumulative exposure to individual metals.

5.2.2. Exposure to Arsenic

People residing in and conducting recreational activities in various areas of the CdA River Basin could have been and continue to be exposed to arsenic in surface soils, surface water, sediments, and possibly groundwater.

East of the Box

ATSDR reviewed the data from various samples collected from locations east of the Box. Given weather conditions in the area, exposures to arsenic in the surface soils, surface water, and sediments are most likely to occur in the late spring, summer, and early fall. The average concentration of arsenic in residential soil east of the Box is 32.62 mg/kg.

Available data suggests that some properties in the Basin have high levels of arsenic (up to 1,700 mg/kg) in surface soil that could pose a health hazard to some preschool children living at those properties.[21] Chronic exposure to arsenic-contaminated soil, as would be seen in pica behavior situation, at the more highly contaminated properties has the potential to cause adverse health effects, such as vomiting, diarrhea, abdominal pain, nephropathy, and leucopenia.

Based upon epidemiological studies, arsenic in soil is likely to be less bioavailable than arsenic in water (NAS 1999, 2001, 2003). The probability of a child coming into contact with the very highly contaminated surface soils for the duration necessary to produce adverse health effects, except in pica behavior situations, is low. Adverse health effects due to acute or short-term exposure to soils at the average concentration are unlikely.

West of the Box

The average and maximum concentrations of arsenic in residential surface soil west of the Box are 25.33 mg/kg and 142 mg/kg, respectively. As is the case east of the Box, the main population of concern would be children who ingest very large quantities of soil. Non-residential surface soils and other media also contain elevated concentrations of arsenic. Exposure to these media could produce the adverse health effects previously mentioned.

It is important to note that the concentrations of arsenic west of the Box are significantly less than the concentrations east of the Box. Therefore, exposures would have to occur at a very high rate than would normally be expected in a residential setting. In addition, CdA River Basin residents should prevent or reduce their exposures to contaminated lead soil. Taking this precaution will help avoid any increased body burden of arsenic, which could increase the likelihood of developing adverse health effects.

5.2.3. Exposure to Cadmium

Residents and non-resident recreational users in the CdA River Basin are likely exposed to cadmium in surface soil, sediment, and surface water. In addition, those living in the Osburn area could also be exposed to cadmium via potable water.

The estimated combined acute exposure dose, however, is at least four orders of magnitude less than the acute exposure dose (2 mg/kg/day) shown to cause delayed ossification of the sternum and ribs in rats (Baranski 1985). ATSDR does not expect adverse non-cancer health effects from acute exposure to cadmium in the CdA River Basin.

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[21] This statement assumes that toxicity characteristics of arsenic in soil would be similar to those observed in humans following accidental poisonings by soluble arsenic compounds.

The estimated intermediate exposure dose is less than one-half the intermediate duration dose shown to cause an increase in systolic blood pressure in rats (Perry et al. 1989). ATSDR does not expect adverse non-cancer health effects from intermediate exposure to cadmium in the CdA River Basin.

The estimated exposure dose for long-term exposure to cadmium in potable water is less than the dose shown to cause renal damage in humans due to chronic exposure. ATSDR does not expect long-term exposure to cadmium in the CdA River Basin to cause adverse non-cancer health effects.

ATSDR has reviewed available human and animal studies to determine if cadmium is carcinogenic by the oral route of exposure. Neither the human nor the animal studies provide sufficient evidence to determine whether or not cadmium is carcinogenic by the oral route. A cancer effect level (CEL) is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiological studies. The CEL in mice for cadmium is 3.5 mg/kg/day. This concentration represents the lowest dose of chemical in a study, or group of studies, that produces significant increases in the incidence of cancer (or tumors) between the exposed population and its appropriate control. The estimated combined exposure dose does not exceed this CEL. Therefore, ATSDR does not expect an increased risk of carcinogenic health effects from cadmium in the CdA River Basin to occur.

In the past, people were exposed to cadmium in ambient air. ATSDR has not published a screening value appropriate for evaluating acute exposure to cadmium in air. For this PHA, ATSDR compared the maximum concentrations to the LOAEL (the lowest dose of chemical in a study, or group of studies, that produces statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control) for cadmium. This comparison revealed that the highest concentration of cadmium in Shoshone County (10.79 $\mu g/m^3$) was more than an order of magnitude lower than the lowest LOAEL (170 $\mu g/m^3$) reported in ATSDR's toxicological profile on cadmium (ATSDR 1999b).

Similarly, because ATSDR has not published screening values for intermediate and chronic exposures to cadmium, the highest detected annual concentration (0.63 $\mu g/m^3$) was compared to the corresponding lowest LOAELs (intermediate exposure, 20 $\mu g/m^3$; chronic exposure, 13.4 $\mu g/m^3$)—a comparison that again revealed that the cadmium levels measured in Shoshone County between 1975 and 1980 were more than an order of magnitude below the lowest LOAELs.[22]

EPA has classified cadmium as a probable human carcinogen when inhaled. However, the highest average annual concentration of cadmium detected in samples from the CdA

[22] Notably, ambient air concentrations of most metals at locations within the Box were significantly higher than those outside the Box, and concentrations of most metals measured prior to 1982 were considerably higher than those measured in more recent years.

River Basin monitoring stations indicate that chronic exposure to cadmium would result in *no apparent increased risk of cancer*.

5.2.4. Exposure to Iron, Manganese, and Thallium

Sampling of the surface soils of the CdA River Basin site detected iron, manganese, and thallium. Generally iron excess does not occur from normal routes of exposure because the absorption of iron is regulated according to need.[23] The combined exposure doses for each evaluated population, from iron-contaminated media were below the dose which may produce adverse health effects. ATSDR believes that no adverse non-cancer health effects would occur due to acute, intermediate, and chronic exposures to iron. People with the rare disease, hemochromatosis (1 in 500 people), have increased absorption of iron from the gut. These individuals could be at increased risk for exposure to iron in the soil.

The estimated exposure doses for intermittent exposure to manganese and thallium are at least two orders of magnitude less than their corresponding NOAEL (the dose of chemical at which there were no statistically or biologically significant increases in the frequency or severity of adverse effects seen between the exposed population and its appropriate control) and LOAELs. Therefore, adverse, non-cancer health effects are not expected from intermittent exposures.

5.2.5. Exposure to Particulate Matter (PM)

ATSDR identified particulate matter (PM) for further evaluation in this public health assessment because air data are available for total suspended particulates. The data reviewed by ATSDR indicate that people residing in or visiting the CdA River Basin east of the Box (particularly in the vicinity of the Osburn Radio Station monitor) may have been exposed to unhealthy levels of total suspended particulates (TSP) and PM. These exposures would have occurred in the past.

Particulate matter is ubiquitous both in the outdoor and indoor environments. Besides the outdoor sources of PM exposures to the community, there are numerous other indoor sources of PM exposures from cooking, cleaning, and other indoor activities (EPA 2002).

Before 1987, EPA regulated PM in air by measuring TSP levels. TSPs are small particles of matter suspended in air, a large portion of which persons can inhale. By 1987, a growing amount of research had shown that the air particles of greatest health concern

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[23] In general, acute iron intoxication remains one of the more common poisonings of childhood. Most of the poisonings occur in children under six years of age. Iron intoxication in young children is usually caused by excessive or accidental ingestion of dietary supplements (FDA 1997). Ingestion of elemental iron in doses greater than 20 mg/kg can produce diarrhea, nausea, vomiting, fatigue, and other effects. Ingesting more than 60 mg/kg can cause significant toxicity; ingesting more than 180 mg/kg is often lethal.

were actually those termed PM_{10}. At the time, PM_{10} was shown to be capable of penetrating into sensitive regions of the respiratory tract.

Consequently, EPA and the states began in 1987 to monitor and regulate outdoor levels of PM_{10}. Since 1987, hundreds of additional studies (mostly human epidemiologic studies) have been published on the health effects of particulate matter, particularly PM_{10}. These studies generally suggest that adverse health effects in children and other sensitive populations were associated with exposure to particle levels well below that allowed by EPA's PM_{10} standard at the time (EPA 1997b). Moreover, fine particles ($PM_{2.5}$) appear to penetrate into the lungs more deeply than can PM_{10} and that fine particles are more likely to contribute to adverse health effects than are particles larger than $PM_{2.5}$.

Important to note is that some scientific debate is occurring about the levels of PM_{10} considered protective for all segments of the population. Threshold concentrations for PM_{10} (i.e., levels below which no adverse health effects are likely) have not been established from the scientific literature. Therefore, the following evaluation of the public health implications of exposure to particulate matter incorporates the understanding that currently no established levels exist below which particulate matter will not cause harmful effects.

5.2.5.1. Background Information About Health Effects from Exposure to PM

Over the past 20 years, numerous investigators have researched the public health implications of inhalation exposure to particulate matter. The following discussion reviews this large volume of research, which provided a basis for much of the evaluation presented late in this section.

According to studies on PM, many health effects were associated with $PM_{2.5}$ exposures or with $PM_{2.5}$ exposures coupled with exposures to other pollutants (EPA 1997). A partial list of these health effects follows:

- premature death;
- respiratory-related hospital admissions and emergency room visits;
- aggravated asthma;
- acute respiratory symptoms, including aggravated coughing and difficult or painful breathing;
- chronic bronchitis; and decreased lung function that can be experienced as shortness of breath.

These studies indicated that the elderly; children; and persons with pre-existing diseases such as diabetes, respiratory disease and cardiovascular disease are considered to be most susceptible to effects of PM (EPA 2002). Others are susceptible to less-serious health effects such as transient increases in respiratory symptoms, decreased lung function, or other physiologic changes. Chronic exposure studies suggest relative broad susceptibility to cumulative effects of long-term repeated exposure to fine particulate pollution, resulting in substantive estimates of population loss of life expectancy in highly polluted environments (Pope 2000). It is important to note that susceptibility is dependent on a number of other important exposure factors, including duration of exposure. The degree to which an added particle burden might impact an individual will likely be affected by that person's age, health status, medication usage, and overall susceptibility to PM inhalation exposures. One factor that might promote increased risk in the older population is that, over their life spans, they might have had more exposure and hence more opportunity to accumulate particles or damage their lungs (EPA 1996). Current epidemiologic research does not provide conclusive evidence of an association between exposure to PM, in general, and cancer. However, because PM is made up of various constituents, depending on the source(s), chemicals that are potential carcinogens are likely to be included in particulate matter.

EPA proposed revisions to its PM standards in 1997 to include a primary (health-based) annual average $PM_{2.5}$ standard of 15 µg/m^3 and a 24-hour $PM_{2.5}$ standard of 65 µg/m^3 (EPA 1997). EPA's scientific review concluded that fine particles are a better surrogate for those components of PM most likely linked to mortality (death) and morbidity (disease) effects at levels below the previous standard. Moreover, fine particles and high concentrations of coarse fraction particles are linked to effects such as aggravation of asthma (EPA 1997, 2002).

The body of scientific knowledge used to set the health-based $PM_{2.5}$ standard consisted primarily of epidemiologic studies of communities exposed to elevated levels of particulate matter. These epidemiologic studies found consistent associations between exposure and adverse health effects both for (a) short-term or acute particulate matter exposure scenarios (i.e., usually measured in days) and (b) long-term or chronic exposure scenarios (i.e., usually measured in years) (EPA 1996, 2002). Chronic exposures are best measured using annual average $PM_{2.5}$ levels (concentrations above 15 µg/m^3) for one or several years. Acute exposures are best measured by using the 24-hour average PM_{10} and $PM_{2.5}$ levels (concentration above 150 µg/m^3 and 65 µg/m^3, respectively). The previous EPA standards for annual average and 24-hour TSP were 75 µg/m^3 and 260 µg/m^3, respectively. Epidemiologic studies indicate increased health risks associated with particulate matter exposures, either alone or in combination with other air pollutants. Moreover, although particulate matter-related increases in individual health risks are small, they are likely significant from an overall public health perspective because of the many persons in susceptible risk groups that are exposed to ambient particulate matter (EPA 1996).

Although the epidemiologic data provide support for the associations mentioned above, a clear understanding of the underlying biological mechanisms of exposures to particulate matter has not yet emerged (EPA 1996, 2002). Much of the toxicological findings related to particulate matter are derived from controlled exposure studies in humans and laboratory animals. However, to date, toxicologic studies on PM have provided important, but limited, evidence for specific PM attributes (constituents) being primarily or essentially responsible for the cardiopulmonary effects linked to ambient PM from epidemiological studies. In most cases, however, exposure concentrations in laboratory studies have been inordinately high as compared to the exposures at which epidemiological studies have found effects (EPA 2002).

These toxicological studies have focused on acidic aerosols (a subclass of particulate matter), namely sulfuric acid aerosols, particle size, inorganic constituents (e.g., various sulfates and nitrates), metals (e.g., transition metals), organic constituents, diesel exhaust particles, and bioaerosols (EPA 2002). Epidemiological studies have also investigated PM from various sources (e.g., motor vehicles, fuel oil, industrial, etc) to determine if exposure to different types of PM indicate a stronger or weaker association with adverse cardiopulmonary health effects. All of these studies indicated that soil or crustal sources of PM were not associated with adverse health effects, as measured by mortality. This suggests that the components of natural soil may have minimal toxicity unless contaminated by anthropogenic (man-made) or other sources, such as transition metals (EPA 2002).

Human exposure studies of particles other than acid aerosols generally provide insufficient data to draw conclusions regarding health effects (EPA 1996). A recent study (Godleski et al. 2000) found that concentrated airborne particles had adverse effects on the electrical regulation of the heart in dogs with a preexisting heart condition, while the impact on normal dogs was not clear. Moreover, biological evidence indicates (Schwartz 1999) that urban combustion particles can:

- penetrate past the primary defense mechanisms of the lung,
- elicit inflammatory changes in the lung and systemically (throughout the body),
- contain constituents (for example, soluble transition metals) that by themselves can be demonstrated to produce lung damage,
- produce electrocardiogram changes including arrhythmia (heart irregularities), and
- kill animals with preexisting heart and lung disease.

Human studies also reported inflammatory changes, including systemic changes and changes to cardiovascular risk factors (Schwarz 1999). A brief summary of some of the epidemiologic and controlled human exposure studies of specific physiologic end points is shown in Table D7, Appendix D. It is important to note that the studies shown in Table E7 are only a sampling of some of the studies that have provided clues into the potential biological mechanism linking PM exposures with adverse health effects, as seen in epidemiological studies. Overall, the human physiologic, toxicological, and other studies have shown changes in either blood plasma viscosity, heart rate, heart rate variability or HRV (HRV refers to the “beat-to-beat” changes in heart rate in relation to changes in physical activity–aging, diseases, and other factors can also effect it), and pulmonary inflammation in relation to particulate matter exposures. In general, it is speculated that interactions among inflammation, abnormal hemostatic function, and altered cardiac rhythm might play an important role in the pathogenesis of cardiopulmonary diseases related to air pollution (particulate matter). An adequate understanding of these relationships is limited and requires further research (Pope 2000). Moreover, although scientific evidence has provided some clues into the biological mechanisms of how particulate matter might elicit adverse health effects in animals and humans, the results of these studies are limited and not always consistent. Therefore, clear evidence of the exact mechanisms has not emerged.

In summary, the epidemiologic evidence strongly suggests that ambient particulate matter exposure is associated with adverse human health effects in many geographic locations in the U.S. (EPA 2002). However, a great deal of uncertainty remains about many issues related to the overall scientific inquiry into the health effects of particulate matter (EPA 1996, 2002). For example, some scientists believe that the association found in the epidemiological studies does not provide conclusive evidence that exposure to ambient PM levels actually causes adverse cardiopulmonary health effects because a clear biological mechanism, among other things, has yet to be established. Moreover, several viewpoints exist on how best to interpret the epidemiologic data (EPA 1996, 2002); for example:

- using particulate matter exposure indicators as surrogate measures of complex ambient air pollution mixtures and using reported particulate matter-related effects to represent those of the overall mixture;
- attributing reported particulate matter-related effects to particulate matter components (per se) of the air pollution mixture, therefore, they reflect independent particulate matter effects; and
- viewing particulate matter both as a surrogate indicator as well as a specific cause of health effects.

Although there are some indications that PM effects vary depending on geographic location and source (EPA 2002), in general, reduction of particulate matter exposure would be expected to lead to reductions in the frequency and severity of particulate matter-associated health effects (EPA 1996).

5.2.5.2. Acute Exposure to 24–hour Average TSP

Early indications that fine particles probably contribute significantly to observed particulate matter disease and mortality effects came from evaluations of past serious air pollution episodes in Britain and the United States. The more severe episodes generally involved several days of calm winds, during which large coarse particles rapidly settled out of the atmosphere and concentrations of fine particles dramatically increased (EPA 1996). Most epidemiologic studies of particulate matter focus on acute exposures (usually daily) and their association with various health end points such as mortality counts, hospitalizations, symptoms, and lung function. Unfortunately, until recently (after publication of the new proposed $PM_{2.5}$ standards), very little daily monitoring of fine particles occurred, and most of the studies used other methods of measuring particulate concentrations, like PM_{10} and TSP (Pope 2000).

A recent major U.S. study evaluated the association between short-term exposures to PM_{10} and other pollutants to morbidity (as measured by hospitalizations) and mortality (Samet et al. 2000). The Health Effects Institute's (HEI) National Morbidity, Mortality, and Air Pollution Study (NMMAPS) used several new and innovative approaches to overcome some of the limitations of previous studies of daily exposures to air pollutants and their relationship to death and hospitalizations. The approach used was to characterize the effects of PM_{10} alone or in combination with gaseous air pollutants in a consistent way, in a large number of cities, using the same statistical approach. The latter study looked at the effects of PM_{10} and other pollutants on mortality in up to 90 of the largest U.S. cities. In addition, the study addressed morbidity, as measured by daily PM_{10} effects on hospitalization among those 65 years of age and older, in 14 U.S. cities. HEI concluded that their study made substantial contributions in addressing major limitations of previous studies.

The results of the mortality studies were generally consistent, with an average approximate 0.5% increase in overall mortality for every 10 $\mu g/m^3$ increase in PM_{10} measured the day before death. This effect was slightly higher for deaths caused by heart and lung disease than for total deaths. The PM_{10} effect on mortality also did not appear to be affected by other pollutants in the model. The 14-city hospital admission study of persons 65 years or older consistently showed an approximate 1% increase in admissions for cardiovascular diseases and about a 2% increase in admissions for pneumonia and chronic obstructive pulmonary disease (COPD) for each 10 $\mu g/m^3$ increase in PM_{10} (Samet et al. 2000).

The results of the NMMAPS study have been brought into question because of an apparent issue with the software used to estimate the risks associated with exposure to air pollutants. Another study re-evaluated the NMMAPS mortality results and has determined that the results are still positive, but it is likely that the actual risk originally calculated will be lowered by about one-half (Dominici, et al. 2002). The re-analysis of the hospital admissions portion of the study is still in progress. In other studies of hospital admissions and visits, a 50 $\mu g/m^3$ increase in PM_{10} resulted in a 3–25% increase in admission and visits for cardiopulmonary diseases (EPA 2002).

Overall, the particulate matter risk estimates from total mortality epidemiologic studies suggest that an increase of 10 $\mu g/m^3$ in the 24-hour average PM_{10} level (or an increase of 5--6 $\mu g/m^3$ in $PM_{2.5}$) is associated with increased risks of adverse health effects of 0.5%--1.5% (Pope 2000), with even higher risks possible for the elderly and for others with preexisting respiratory conditions (EPA 1996).

The Bunker Hill facility likely contributes to increased PM_{10} exposures to persons living near the facility. On some days PM_{10} levels were appreciably elevated due to Bunker Hill emissions. These increases in short-term PM_{10} levels likely resulted in an increased risk for adverse cardiopulmonary health outcomes for those exposed (especially the elderly and those persons with preexisting heart and lung illnesses). However, PM from the Bunker Hill Facility would have ended in 1981 with the closing of the smelter.

Several studies have evaluated TSP exposures in relation to deaths and other health outcomes, such as hospital admissions. Although results are mixed, the analyses generally showed a 1% to 5% increase in total deaths for every 100 $\mu g/m^3$ increase in TSP. Moreover, for total respiratory or COPD hospital admissions in the elderly (aged 65+ years), an approximate 10%--50% increase occurred for every 100 $\mu g/m^3$ increase in TSP (EPA 1996; Schwartz 1995).

These epidemiologic studies suggest that on several occasions from 1974 through 1985 the maximum 24-hour levels of TSP exceeded concentrations associated with adverse respiratory health effects. According to the epidemiologic literature, some of the adverse health effects associated with the range of maximum 24-hour TSP levels are increased total acute mortality, increased hospital admissions for the elderly for lung disease, including COPD (EPA 1996). The greatest concern for adverse health effects for short-term exposures to the higher levels of TSP would be the elderly and those persons with preexisting heart and lung illnesses.

The population exposed to Bunker Hill emissions was relatively small; therefore, deaths from exposure to the levels of PM associated with Bunker Hill emissions are unlikely to form a discernable pattern. More probable is that susceptible persons exposed would experience lung and heart symptoms and reduced lung function that may lead to a doctor's visit, emergency room visit, or hospitalization.

5.2.5.3. Exposure to Particulate Matter since 1988 and Possible Current Health Effects

As indicated above, TSP and PM_{10} levels in the CdA River Basin fell after 1981, when the Bunker Hill Smelting operation ceased. Since 1991, neither have been measured at levels that exceeded air quality standards. The levels of PM in the area and subsequent risk of an adverse heart and lung health outcome were similar to those in many areas of Idaho and the U.S.

5.2.6. Exposure to Sulfur Dioxide (SO_2)

In the past, residents and visitors near the Osburn Radio Station may have been exposed to sulfur dioxide at unhealthy levels in ambient air. The highest 24-hour average concentration measured was 407 $\mu g/m^3$, and the highest annual average measured was 48.7 $\mu g/m^3$. These measurements were taken in 1976. The exposures could have lasted for several hours or many hours. People in the area may have experienced an increase in airway resistance and bronchoconstriction[24] (Linn et al. 1983; Schachter et al. 1984; Bethel et al. 1985; Myers et al. 1986a and 1986b). People with asthma who were exercising at the time of exposure to sulfur dioxide were the most likely to experience these symptoms first. As sulfur dioxide levels rose, persons with asthma who were not exercising, as well as persons without asthma, would also start to experience symptoms.

5.2.7. Exposure to PCB–Contaminated Fish

The State of Washington has issued a fish advisory for fish caught in the Spokane River because of PCB contamination (WDOH publication # 09-02-076 update, March 2001). Fish in some parts of the Spokane River have been contaminated at concentrations high

[24] An increase in airway resistance means that air traveling through the airway passages in the lungs was meeting more resistance. It is a precursor to bronchoconstriction, which is the narrowing of the air passages in the lungs. If bronchoconstriction is severe, wheezing and difficulty breathing can occur.

enough to cause adverse health effects in some individuals (e.g., young children, pregnant women, and women considering pregnancy). Therefore, some species of Spokane River fish such as large scale suckers caught between Upriver Dam and the Washington/Idaho state line and rainbow trout, mountain whitefish, and large scale suckers caught below Upriver Dam to Nine Mile Dam, should be consumed only occasionally (one meal or less per month); some such as rainbow trout and mountain whitefish caught between Upriver Dam and the Washington/Idaho state line should not be eaten at all. In any case, because whole fish tend to contain higher concentrations of contaminants, people who eat the fish should eat only the fillet. Notably, the PCB contamination is not thought to be related to mining wastes (WDOE 1995).

5.2.8. Exposures Related to Modern Subsistence Lifestyle

ATSDR has determined that if a person were to use contaminated resources in a manner consistent with a modern subsistence lifestyle, that person would be at increased risk for adverse health effects from increased body burden of lead. These adverse effects could include but are not limited to: elevated blood lead levels leading to behavior and learning problems, kidney damage, hypertension, damage to the central nervous system, growth retardation and anemia.

ATSDR has concluded, based on available data that the number of fish meals consumed of aquatic biota taken from Lake Coeur d'Alene should be limited. The risk of adverse health effects is greater for those individuals consuming whole fish than for those consuming fish fillets. Risk of adverse effects would likely increase also for those individuals who have existing blood lead level greater than 6-7 micrograms per deciliter (ATSDR 2003). The concentration of organic mercury found in fish tissue samples also presents a health hazard to those living a subsistence lifestyle. Organic mercury exposure is more dangerous for young children than adults because the organic mercury more easily passes into the developing brain of young children and may interfere with developmental processes. Organic mercury that enters the body can be converted to inorganic mercury which can lead to kidney damage. The concentration of arsenic found in fish tissue samples may increase the risk of cancer in individuals with subsistence lifestyles.

It is a desire of many Tribal members to return to a traditional subsistence lifestyle. However, given the current level of contamination within the CdA River Basin such a change in the foreseeable future is not advised.

5.2.9. Combined Health Effects

ATSDR has released a report that evaluates the possibility of interactive effects from exposure to several metals, including arsenic and lead. This report is called the Interaction Profile for Arsenic, Cadmium, Chromium, and Lead.

The report concludes that if the combined exposure to arsenic and lead are high enough evidence suggests that there might be a greater potential for causing neurological effects than exposure to lead or arsenic alone (ATSDR 2002). A study in children suggests that exposure to lead increases scores for maladaptive classroom behavior with higher scores for maladaptive behavior in children with lead and arsenic exposure. In addition, the study suggests that exposure to arsenic decreases reading and spelling performance and is further decreased in children with arsenic and lead exposure (Marlow 1985, Moon 1985).

Several factors need to be considered when understanding the conclusions from the Marlow and Moon study. Because of the limited number of studies in humans it should be emphasized that the conclusion about possible interactive effects between arsenic and lead is only suggestive and not definite (ATSDR 2002). In addition, this study used the level of arsenic and lead in children's hair as an indicator of exposure. Hair levels may indicate contact with a chemical rather than ingestion of a chemical. For instance, children might come into contact with lead and arsenic in dirt. The lead and arsenic can be transferred directly to the hair from dirt without actually exposing the child. Therefore, hair levels may not indicate actual intake of lead or arsenic.

When conducting human studies, scientists know to take into account certain variables that might affect a child's performance. For instance, Marlow and Moon controlled for variable such as the parents' age at their child's birth, parents' occupation and education, father's social class, father's presence in the home, child's birth weight, and child's length of hospitalization. The authors, however, did not control for the child's care-giving environment and the child's nutritional status. Not controlling for these two important variables casts some doubt on the conclusions. For these reasons, the conclusion about possible interactive effects between lead and arsenic are suggestive of additive effects but not definite (ATSDR 2002). Another drawback also exists when trying to use the conclusions about possible adverse effects based on hair levels. In the case of children living in the CdA River Basin site, it is not possible to estimate their dose for arsenic and lead from ingesting soil and decide if the effects reported by Marlow and Moon are possible.

As indicated by the previous discussion, residents at the site may be exposed to lead at doses that pose a public health hazard. Blood testing has identified children with blood lead levels in excess of 10 µg/dL–a level at which adverse neurological, hematological, and other health effects may occur. In addition to lead exposure, residents at the site may be exposed to arsenic and cadmium. Experimental studies have shown that exposure to mixtures of lead and arsenic and lead and cadmium can cause additive or greater than additive toxicity for health effects, such as the inhibition of heme synthesis (Mahaffey et al. 1981). Therefore, exposures to mixtures of these metals can result in increased toxicity and adverse health effects.

6. CHILD HEALTH CONSIDERATIONS

To ensure that the health of the nation's children is protected, ATSDR requires that public health assessments determine whether children are being exposed to site-related hazardous waste and whether contaminants may affect children's health.

Children are thought to have greater exposure to contaminants in soil and dust than adults, and soil and dust are pathways of concern at the CdA River Basin site. In the CdA River Basin, young children often have limited places to play, and when not at their home or at school, they are often found on commercial properties or other common areas (TerraGraphics 2000a). As a result, ATSDR particularly focused on children's exposures to metals in soil and dust, as well as on potential health effects.

ATSDR has assessed how contamination in the CdA River Basin might affect children's health by examining high-end exposures among children in the CdA River Basin as well as exposures among children with soil-pica behavior. As noted previously, pica behavior is estimated to occur in 4% to 21% of the general population of children. The Public Health Implications (5) and Evaluation of Health Outcome Data (7) sections of this health assessment describe soil-pica behavior in more detail.

7. EVALUATION OF HEALTH OUTCOME DATA

ATSDR conducts a review of health outcome data when the toxicological evaluation indicates adverse health outcomes are plausibly associated with the observed levels of exposure. The evaluation of health outcome data can give a general picture of the health of the community. It can also confirm or rule out the presence of excess (higher than expected) disease or illness in a community. Elevated rates of a particular disease may not, however, necessarily be caused by hazardous substances in the environment. Other factors, such as personal hygiene habits, socioeconomic status, and occupation can also influence the development of disease. Inversely, the lack of elevated rates of disease does not rule out, necessarily, the possibility that a contaminant may have caused some illness or disease.

ATSDR did not have blood lead data or other health outcome data for Tribal members to evaluate.

The following section discusses selected CdA River Basin health studies (including exposure assessments) and area blood lead data.

7.1. Lead Studies

7.1.1. Studies Conducted by ATSDR

A) To identify potential risk factors for elevated blood-lead levels, ATSDR conducted a case-control study of children in the CdA River Basin (ATSDR 1995). The study's purpose was to assess certain factors previously known to have influenced blood-lead levels. These factors were mouthing behaviors (such as sucking fingers), hand-washing habits, outdoor activities of children, remediation activities, house dust lead levels, and occupational and recreational activities of other members of the household.

Subjects for the study were some of the children who participated in a 1992 Silver Valley blood lead screening conducted by the Idaho Department of Health and Welfare (IDHW). ATSDR's study included children from Kellogg, Page, Smelterville, and Wardner. Environmental lead levels in these towns had been shown to be higher than in other local areas. Cases were those children whose blood-lead levels had been reported at ≥10 micrograms µg/dL. Controls were children reported at <10µg/dL in the 1992 screening. Cases and controls were matched by age and sex.

The study conducted data analyses of 138 participants (69 matched pairs). In-person interviews provided information on risk factors, and IDHW contributed the environmental data. The environmental data consisted of soil-lead concentration data and dust-sample data from households of children who participated in the 1992 screening.

The overall finding was that lead in soil is related to blood-lead levels. This finding was consistent with the results of previous studies of children from the Silver Valley area, as well as with other studies of risk factors for elevated blood-lead levels. The study observed a protective effect for yard soil remediation (OR=0.29; 95% CI=0.09–0.88, adjusted by income and education). This observation supported the link between soil contamination and elevated blood-lead levels, and it demonstrated that the intervention benefited this community.

As time passed following the close of the Bunker Hill smelter, airborne contamination levels decreased and blood-lead levels have fallen. Remediation and education efforts within the Bunker Hill OU1 site could also have played a role in the drop in children's blood-lead level. As these activities are carried out in the CdA River Basin site, ATSDR expects children's blood-lead levels to decrease.

This study used the presence or absence of soil remediation as a surrogate for soil lead levels. The study used this method to examine the influence of soil lead on blood lead. Inferences of any effects of soil lead levels or household dust lead levels on blood-lead levels were not made in the study because of the limited amount of data. Possible associations between these variables and elevated blood-lead levels have been observed in other epidemiological studies.

This study's recommendations were to continue remediating yard soil and to consider conducting soil sampling or yard soil remediation for other households, specifically those not considered for remediation previously and in which children with elevated blood-lead levels could spend several hours a day (for example, the homes of relatives or friends of the family).

In addition, the study suggested that soil contamination might explain an apparent association between having pets going in and out of the house and elevated blood-lead levels. The study therefore recommended that pets should be bathed often, that children not sleep with pets, that children should wash their hands after playing with any pet and, if possible, that owners restrict pet movement in and out of the house.

B) In another study, ATSDR reconstructed a cohort of previous and current residents of the Silver Valley to investigate the long-term effects of lead exposure. The study evaluated whether previous ambient exposure levels of lead during childhood are associated with adult neurologic, reproductive, or kidney effects (ATSDR 1997b). The acute toxic effects following exposure to lead have been described in the literature and are known to cause these effects; however, whether these effects continue over time is not known (ATSDR 1997b).

The study population consisted of males and females who lived in the Silver Valley during the years 1974 and 1975 and who were aged nine months to nine years during this period. The study defined the Silver Valley as the towns of Kellogg, Smelterville, Wardner, Page, and Pinehurst. The subjects also had to have lived in one of the five towns for six months or more. The comparison group consisted of Spokane, Washington, residents of the same age group who were identified through drivers' license records.

This study had two phases. Phase I was a standardized questionnaire given to exposed and unexposed groups via telephone. The questionnaire included information about residential and occupational histories, socio-demographic characteristics, medical and reproductive histories, and neurologic and kidney disorders. The study interviewed 917 exposed people and 754 unexposed people.

In Phase II, which researchers performed on a random sample of people in the two groups who completed the questionnaire, participants took part in testing and exposure quantification of lead body burden (bone lead concentration) using K X-ray Fluorescence (K-XRF). This technique uses a low effective dose of gamma rays to estimate bone lead content. Measurements were made of the left tibia midshaft, which is approximately 95% cortical bone with a retention time for lead estimated to be decades. Testing measured bone lead in 262 (93.2%) exposed and 268 (93.3%) unexposed participants. The study used a neurobehavioral test battery to determine the functional toxicity of participants, and kidney function tests were performed on each participant.

This study had several important findings. The test subjects reported a statistically significant increase in the prevalence of central nervous system and peripheral nervous system symptoms when compared with the comparison group (4.4 CNS symptoms versus 2.7 CNS symptoms, respectively). In this study, 20% of unexposed participants reported more than four symptoms compared to 43% of exposed subjects. In addition, with statistically significant consistency the test group performed more poorly than did the comparison group on neurobehavioral tests that determine the functional capacity of the central and peripheral nervous systems. The elevated prevalence of neurologic symptoms and poorer performance on neurologic tests could not be attributed to age, sex, or education.

In this study, the average bone lead level for exposed and unexposed participants was 4.6 and .60 microgram per gram (µg/g) bone mineral, respectively; this difference between groups was statistically significant. An age-related increasing dose-response relationship was observed. The age groups 19 through 21, 22 through 24, 25 through 27, and 28 through 30 had average bone-lead levels of 1.38, 4.24, 5.25, and 7.49 µg/g bone mineral, respectively. The study noted that the dose-response relation in the exposed participants might reflect the duration of residence in the Silver Valley. Because of the baghouse fire lead emissions were high in 1973. After 1982, the smelter stopped production. The results of the K-XRF exposure measurements suggested that the test group had significantly higher concentrations of lead stored in their bones than did unexposed participants. The bone lead concentration also increased with increasing duration of residence in the Silver Valley. The higher bone-lead concentration did not appear to be reflective of occupations, hobbies, or sex.

The study also found a significant increase in the prevalence of difficulty conceiving children, which also increased with duration of residence in the valley. The risk of infertility was 1.5 times more likely to be reported in the exposed than in the unexposed population when the bone-lead concentration was ≥9.33 µg/g bone mineral. Again, this increase could not be attributed to age, sex, or education. That said, however, other potential confounders of infertility were not investigated and could have potentially biased the reproductive results of the study. Other self-reported medical conditions that were significantly elevated included anemia, anxiety, history of high blood pressure, urinary tract conditions, ulcers, arthritis, poor circulation, and history of dialysis among family members.

This study recommended that the study cohort be reevaluated to determine whether the health problems identified persist into the future and/or whether new problems, such as kidney disease, have developed. It also recommended that the next evaluation include bone-lead measurement using K-XRF to determine bone-lead mobilization.

C) ATSDR also conducted a cross-sectional study of female former workers of the Bunker Hill facility (ATSDR 1997a). This study examined the long-term effects of lead exposures on women, particularly the interaction of lead and the bone demineralization that occurs as women age. The body's long-term storage of lead is in bone and, as is widely known, lead can be released from bone stores during periods of demineralization, such as osteoporosis, pregnancy, and lactation (ATSDR 1999a).

The exposed subjects in this study were women who had worked at the Bunker Hill facility for at least 30 days in the 1970s. The women in the exposed group also lived near the facility at the time they worked there. They were thus subject to exposures from residential contamination as well. Researchers interviewed 140 former workers. The comparison group included 121 age-matched women selected randomly from among Spokane, Washington, residents through Department of Motor Vehicle records.

Blood for current lead measurement was drawn from former workers and from the comparison group. Using K-XRF, ATSDR measured participants' tibiae to estimate bone lead.

One limitation of this study was that that the disease symptoms of the participants were all self-reported. Another was that the equipment to measure bone density was not available in the communities where the exposed workers had lived. It was, however, available in Spokane.

This study concluded that former workers at the facility had significantly higher bone and blood-lead levels than did women in the comparison group. In addition, the exposed group reported a statistically significant higher number of neurobehavioral symptoms or had been told they had hypertension, anemia, cancer, arthritis, and osteoporosis. Except for cancer, each of these conditions can be associated with increased exposure to lead.

ATSDR recommended that the health of this cohort be tracked to assess health risks in the future. ATSDR also recommended that they be considered for medical monitoring—periodic screening for diseases for which they are at risk because of exposure. ATSDR also recommended that the women discuss with their primary care provider hormone replacement therapy and calcium supplements to decrease bone's uptake of lead

D) Another study involved a cooperative effort between ATSDR and the Idaho State Health Department, the Indian Health Service, and the Idaho Department of Fish and Game (ATSDR 1989). This study focused on whether eating from Lake Coeur d'Alene and the CdA River, as well from adjacent chain lakes, could substantially increase lead and cadmium levels in human blood and urine. The goals of this pilot exposure study were to characterize fish and duck consumption patterns of people living around Lake CdA and thus to determine the association between fish and duck consumption and lead and cadmium levels.

The study population was composed of three fish consumer groups: Coeur d'Alene Tribal members, holders of 1985 fishing licenses who lived in Benewah or Kootenai Counties, and volunteers from the same counties.

This study found that the lead and cadmium levels among participants living near Lake Coeur d'Alene were within the expected range and were not of any known clinical importance. The study detected no statistically significant association between fish or duck consumption and blood-lead levels.

After adjusting for age, smoking, and duck consumption, ATSDR found that people eating at least one fish meal per month were 3.4 times more likely to have urine cadmium levels greater than the median value of 0.2 nanogram per milliliter (ng/ml) as compared with persons who do not eat fish. Individuals who consumed duck within a month prior to the study were 2.1 times more likely to have urine cadmium levels greater than the median as compared with those who did not eat duck. These results, however, were not statistically significant with respect the blood cadmium or urine cadmium adjusted for creatine.

7.1.2. Studies Conducted by Idaho Department of Health and Welfare

During the summer of 1996, the Idaho Department of Health and Welfare's Division of Health in cooperation with the Panhandle Health District (PHD) conducted an environmental health exposure assessment of residents in the CdA River Basin (ATSDR 2000b). The study, funded by ATSDR, sought to identify high-risk children by assessing exposure to lead and cadmium and, if present, to obtain a better understanding of the associations between contamination from heavy metals, personal behaviors, and elevated levels of blood lead and urine cadmium. ATSDR found that although the IDHW did not intend to characterize the CdA River Basin population in this study, it nonetheless best represented the Basin population.

The investigation used a cross-sectional design to assess exposure and meet the two study objectives: 1) to estimate the extent to which the population residing outside the Box in the CdA River Basin study area has elevated blood lead and urine cadmium levels, and 2) to identify and describe the strength of association of risk factors associated with elevated levels of lead and cadmium.

The study population included those who lived throughout the CdA River Basin, from approximately 53 miles from the Idaho/Montana border to near Lake Coeur d'Alene in the Lower Basin. Persons eligible for participation in this study were residents who lived outside the Box within and up to 1.5 miles beyond the 100-year flood plain of the South Fork and main stem of the CdA River. No minimum residence time requirement was necessary to be eligible for participation.

Before collecting data, IDHW held public meetings and availability sessions. IDHW also made public health education materials on relevant issues available for the meetings and for distribution during the data collection period.

Data collection activities consisted of (1) conducting a door-to-door survey with various attempts to contact residents to request their participation in the study; (2) distributing household and individual questionnaires; (3) collecting biological samples (blood and urine); and (4) collecting environmental samples (soil, well water, vacuum dust, floor mat dust, and house paint).

The study's limitations included the following:

- It was not comparative (results could not be compared to persons living outside of the study);
- A low participation rate among the population of most interest (e.g., children less than 10 years of age);
- The relatively small number of participants caused an inability to detect significant relationships between potential risk factors and elevated biological measures; and
- The levels of lead and cadmium were below the detection limits of some of the methods used for some biological and environmental samples; this fact affected the arithmetic and geometric means of the blood lead and urinary cadmium levels.

Of the study participants under 6 years of age, 14.9% had blood-lead levels ≥10 µg/dL. The arithmetic mean blood lead among this age group was 5.40 µg/dL. In addition, among children under 10 years of age, 15.3% had elevated blood lead. The arithmetic mean blood lead for this group was 5.20 µg/dL. Testing detected elevated urine cadmium primarily among persons aged 50 years or older and demonstrated that elevated levels were related to smoking behaviors of individuals within the household. This study recommended that local agencies provide and improve access to grassy or other covered surface play areas for children. It also recommended offering blood lead screening for children under 10 years of age, encouraging smoking cessation, and aiming public health education intervention toward the general population within the Basin.

7.1.3. Additional Health and Exposure Data

The PHD offers voluntary blood-lead testing at several locations in the CdA River Basin annually.

ATSDR received summary statistics from the blood lead screening effort conducted during summer 2002. The number of children aged up to 6 years tested within the CdA River Basin and within the Box were 103 and 259, respectively. Of the 103 children tested in the Basin and residing outside of the Box (35 west of the Box and 68 east of the Box), four (4%) had blood-lead levels ≥10 µg/dL. No individual tested had a blood-lead level in excess of 13 µg/dL. During summer 2003, the number of children aged up to 6 years tested within the CdA River Basin, east and west of the Box were 34 and 41, respectively. Of the 75 children tested, five (nearly 7%) had blood-lead levels ≥10 µg /dL. These five children resided west of the Box at the time they were tested. The children tested during the sampling events may not accurately represent the overall population of children living in the Basin. Because blood-lead testing is voluntary, the true number of those with blood lead in excess of 10 µg/dL may never be established.

ATSDR's review of summary statistics from blood lead screening efforts conducted in the CdA River Basin from 1990 to 2002 indicate that within the Box the percentage of children with blood-lead levels in excess of 10 µg/dL is decreasing. Of the children tested in 1990, 37% had blood-lead levels in excess of 10 µg/dL. Of the children tested in 2002, that percentage had dropped to 2%. This drop may be the result of several factors, and the summary statistics alone do not allow ATSDR to determine precisely whether the drop in blood-lead levels stems from remedial and educational efforts or from some other factor.

On the basis of significant experience at other sites, however, ATSDR believes that educational and remedial efforts are substantial contributors to the decline in blood-lead levels. Therefore, ATSDR strongly recommends continued educational and remedial activities throughout the Basin.

7.2. Independent Evaluation of Bunker Hill Site

On July 14, 2005 the National Academy of Sciences (NAS) released a prepublication report entitled "Superfund and Mining Megasites-Lessons learned from the Coeur d'Alene River Basin." A copy of the document can be obtained at: (http://yosemite.epa.gov/r10/cleanup.nsf/0/ee193bfb20c62b2d8825703e006e17c6?OpenDocument).

The committee was instructed to conduct an independent evaluation of the Coeur d'Alene (CdA) River Basin Superfund site in northern Idaho as a case study to examine EPA's scientific and technical practices in Superfund megasites, including physical site definition, human and ecological risk assessment, remedial planning, and decision making.

This section of the PHA summarizes findings in the report which are relevant to ATSDR/CDC and its public health programs and mission.

The two ATSDR reports which were most frequently cited and discussed in the NAS study were:

1) Coeur d'Alene River Basin Environmental Health Assessment, August 2000
2) Health Consultation, Basin-Wide Residential Properties Sampled Under Field Sampling Plan Addendum 06 (FSP06), May 2000

References to and discussion of the Environmental Health Assessment (a.k.a. 1996 Study) centered around site characterization used in the EPA's Human Health Risk Assessment, including environmental sample results and biological monitoring which took place in 1996. The 1996 study was funded by ATSDR but primarily carried out by the Idaho Dept. of Health and Welfare. This study was the first concerted attempt to characterize exposures through biological sampling in the CdA Basin, and in one instance, was described by the NAS as the only attempt at population based sampling for characterizing blood lead distribution in the Basin.

Nearly 3 pages of the NAS study (pgs 182-184) were devoted to discussing the 2000 Health Consultation and its findings. This evaluation occurred in the context of assessing EPA's use of the IEUBK model for decision making in the CdA Basin. The health consultation had estimated blood lead concentrations at residential properties using three different models. The NAS then undertook their own multi-model evaluation of the same dataset with some modifications and the inclusion of an additional model (O'Flaherty). See Appendix E.

A primary topic of discussion was blood lead screening/monitoring in the CdA Basin, and ATSDR was specifically mentioned at several places during these discussions (more detail under relevant recommendations). Most if not all references to CDC were related to blood lead guidelines.

Recommendations specifically or potentially applicable to ATSDR/CDC are:

Pg. 5 (page numbers refer to location in NAS report)

"Health Surveillance activities conducted or sponsored by local, state, or federal (for example, the Agency for Toxic Substances and Disease Registry [ATSDR] or EPA) entities should include the following:

- Annual blood lead screening of all children 1-4 years old who live in the basin. Screening should be coordinated with local health care providers and timed to coincide with other routine health care screening tests. These data would be useful for evaluating the efficacy of the remedial activities.
- Health interventions that address possible consequences of chronic psychological stress. These may have significant community benefits and should be implemented before or concurrent with cleanup efforts.
- Continued research at the national level on biomarkers of human arsenic exposure to strengthen future HHRAs."

Pg. 6

NAS recommends epidemiological studies to assess the reliability of the IEUBK model.

NAS recommends blood lead studies to characterize the IEUBK model uncertainties.

Pg 134.

This discussion recommends how impacts from hazardous waste sites should be evaluated for Native American tribes in general and specifically for the Basin.

Pg. 135-142

This section discusses the ideal blood lead screening methodology, including interventions.

Pg. 158

NAS states a need for biological indicators of actual human exposure to arsenic and recommends support for continued research on this issue.

Pg. 159

NAS recommends universal and annual blood lead screening of children 1-4 years of age.

Pg. 160

NAS recommends health interventions that address chronic stress in the community before or concurrent with cleanup efforts.

Pg. 208

Criteria should be established upon which to judge whether or not the extant blood-lead observations are representative of the community concerned, covering the full range of lead exposure potential. If "significant" differences exist between observed and predicted blood-lead values, such criteria would establish whether additional blood-lead study effort was required

In addition, definitive guidelines for the conduct of blood-lead studies should be established. The focus should be on the coherence of the joint data set covering the full range of lead exposure risks and the collection of blood-lead data associated with that range of exposure

Pg. 298

NAS discusses the negative impact of Superfund designation on economics in the Basin, and suggests that it is unfortunate that some statements or site descriptions refer to the entire 1500-square-mile project area as the site, whereas the contaminated area designated as OU-3 is very much more limited.

In response to some of these recommendations, ATSDR has made adjustments to this PHA as appropriate. ATSDR has reiterated throughout the PHA that not all of the CdA River Basin is contaminated with lead and other metals. ATSDR supports the NAS recommendations regarding blood lead screening in the CdA River Basin. As discussed in section 11.2 of this PHA, ATSDR and CDC's National Center for Environmental Health will assist local citizens groups and local health and environmental agencies in developing an appropriate blood-lead monitoring program for young children in high risk areas for lead poisoning and other environmental hazards. ATSDR's Division of Health Assessment and Consultation's Health Promotion and Community Involvement Branch will work with CdA River Basin community members to identify additional site-related environmental health concerns.

8. DISCUSSION OF COMMUNITY HEALTH–RELATED CONCERNS

ATSDR conducted several public availability sessions in selected CdA River Basin communities. The purpose of these public availability sessions was to solicit community concerns and inform and educate residents living near in the CdA River Basin site. The concerns expressed by the residents and ATSDR's response to those concerns are listed below.

8.1. Impact on Economy

Some attendees at these meetings expressed concern that ATSDR would label the Basin a Public Health Hazard, which they felt would potentially impact the area economy. They were most concerned about Lake Coeur d'Alene and other recreational areas. ATSDR explained that one of our requirements in producing a public health assessment is assigning a hazard category to the site. ATSDR further explained that when analysis shows that an unremediated site may produce health effects, ATSDR must classify that site a "public health hazard." This category does not mean that it is unsafe for people to live and recreate in the Basin. It does mean, however, that actions to reduce site contamination are warranted. To meet the expressed concern, ATSDR agreed to delineate the hazard category in such a way as to identify clearly which areas of the Basin pose a possible public health hazard.

8.2. Disease Clusters

Some local residents expressed concerns about what they perceive to be disease clusters and asked about health investigations looking into possible clusters. ATSDR has performed a number of health studies in the past involving residents of the Bunker Hill site. ATSDR has also looked at former workers at the smelter (see Health Outcome Data Evaluation, above). Typically, health studies are unable to make statistically significant links between diseases and environmental exposures unless the population under study is quite large or the exposures are very high. ATSDR explained that the population living in the area of concern is simply not large enough to detect elevated rates of disease using standard health study methodologies.

8.3. Trail of the Coeur d'Alenes

Residents also raised concerns about the possibility of disease clusters near the TCdA. Residents perceive possible disease clusters in areas of the Lower Basin. Reported illnesses of concern include autoimmune related disorders including Graves Disease, fibromyalgia, lupus, thyroid disease, and pemphigus vulgarus, in addition to cases of cancer. Some community members feel that many of these diseases occur at rates higher than would be expected in the general population. They also believe that these diseases and other health effects cases may be related to heavy metals remaining in the area.

ATSDR has investigated the potential associations between the autoimmune diseases reported and several metals of concern, including lead, arsenic, cadmium, and zinc. Although a number of studies have investigated this relationship, most are based on animal research. The available literature shows some evidence for immunological disruption by some metals, but does not report an association for the specific diseases identified as community concerns.

Residents also expressed concerns about the levels of contaminants along the TCdA. The information gathered from the reports used to develop the TCdA indicates that some precautions have been taken, such as removal of contaminated soil in the immediate vicinity of the TCdA where possible and the construction of barriers in addition to posted warnings (see Figures 7–9).

ATSDR is aware that many areas along the 73 miles of trail are not well signed or fenced, however. Leaving the TCdA and entering uncontrolled areas is of particular concern for local residents, especially children, who may already have lead and other exposures in their normal living environment. In particular, areas along the river west of the Box allow access to the contaminated sands of the river bank. The frequency of such exposures would probably be low, however, so the potential for health concern is generally low.

ATSDR believes that if people were to stay on the main portion of the TCdA itself, they should not experience any increased adverse health effects from use of the TCdA. Nonetheless, previous experience suggests that that the likelihood of all TCdA users remaining on the trail itself is quite low. Hikers and other users may venture into areas beyond the right-of-way (ROW) which have not been cleaned up or otherwise remediated. Experience also suggests that people are likely to ignore warnings and use the TCdA to access local waters and scenic areas.

Therefore, ATSDR emphasizes that TCdA users should remain on the trail. If direct contact exposure to contaminated media occurs, the exposed area of the body should be washed.

Maintenance workers for the TCdA could be exposed to underlying contamination while performing maintenance activities on the TCdA and its supporting structures. Such persons should receive appropriate training on avoiding contact with and handling of hazardous wastes as well as on the proper protective equipment. Such training should avoid or reduce substantial exposures. ATSDR also recommends posting more signs along the 73-mile trail and its access points.

8.4. Children Health Concerns

ATSDR recognizes the increased potential susceptibility of children to heavy metals, particularly lead. For young children, the primary source of exposure to lead is in the home. Children and all users of the TCdA should remain on the trail and avoid posted areas known to be contaminated by lead and other metals.

9. CONCLUSIONS

The Coeur d'Alene River Basin site is a large and complex Superfund site. Mining, mineral processing activities and the natural movement of mining-related materials has resulted in wide-spread contamination of various environmental media with metals. These metals include lead, arsenic, cadmium, and others. Because of the multiple sources and processes, the metal contamination within CdA River Basin site varies from location to location. Therefore, the specific localized public health hazard associated with the metal contamination will be highly dependent upon the specific situations within the CdA River Basin site. At this point ATSDR will reiterate that not all portions of the CdA River Basin site are contaminated. Outside of OU1 and OU2 transport of contaminants from hillsides and tailings piles under the force of river flow and erosion, particularly during flood events, has contributed to contamination. Surface waters continue to carry tailings, contaminated sediments, and dissolved metals to areas west of the Box. As a result, virtually all soils located in the floodplains of the South Fork CdA River and CdA River are potentially contaminated. However, the concentrations of these contaminants, in most locations, are not at levels which could represent a human health threat.

Detailed below are ATSDR's general conclusions regarding the public health hazards associated with the major locations/situations for this site. However, these general conclusions may not adequately address localized factors and types of contamination. Situation-specific evaluations may be necessary.

A fact sheet describing ATSDR's Public Health Conclusion Categories is included in Appendix H.

9.1. Current Site Conditions and Exposures

9.1.1. Exposures of Concern to Residents

Some areas of the CdA River Basin site east of Lake Coeur d'Alene are currently a public health hazard for local residents. This hazard results from high levels of lead and other metals in various media (including surface soil, household dust, and fish), possible long-term exposure to contaminants, and documented elevated blood-lead levels in children.

ATSDR believes that exposure to lead in soil or household dust is a likely contributor to the elevated blood-lead levels in residents. However, residents also may be exposed to lead via additional environmental media including lead-based paint.

Aquatic biota from Lake CdA represents a public health hazard based upon levels of lead, arsenic, and mercury in sentinel fish species. In addition bed sediments within Lake CdA are contaminated with high concentrations of metals which can become suspended in the water column and thereby cause surface water contamination. This could further impact exposure pathways. Data from areas west of Lake CdA (within the State of Idaho), however, indicate no apparent public health hazard.

In addition, residential exposure to contaminated household dusts and residential soils has been shown to be the completed pathway of greatest concern. Not all residential soils in the Basin, however, are highly contaminated by metals. Nevertheless, homes with young children, children with cognitive deficits/disabilities, pregnant women, or a combination of these sensitive groups are of most concern. Efforts to identify such households and remediate any problems found are underway.

Water

Municipal and community water systems in the Silver Valley are regulated by the Safe Drinking Water Act. Owners of water systems monitor their water quality for contaminant levels. Those systems found to have metals contamination above the maximum contaminant level have been diluted with water from non-contaminated sources to bring them into compliance, have disconnected contaminated sources to prevent usage, or are undergoing corrosion treatment. Residences using non-regulated water sources and found to have contaminated water supplies have received end-of-tap water purification, have been hooked-up to a regulated water system, or now receive water from some alternate source. Exhaustive sampling of private wells within the CdA River Basin, however, has not been conducted.

Evidence suggests that some residents divert water from adits, ponds, and other non-regulated water bodies for potable use. ATSDR does not have data from these non-regulated sources to evaluate. Even so, ATSDR believes some may pose a public health concern, particularly those near piles of tailings.

Soil/Dust

Residents with elevated soil/dust levels of metals in their residences or who have other sources of potential exposure, such as consuming area fish, animals, or plants, should prevent or reduce exposure when recreating at CUAs in the Basin. Some of these precautions may include avoiding ingestion of surface water, frequent washing of hands and other areas of direct contact exposure, and avoiding areas known to be contaminated.

Trail of the Coeur d'Alenes (TCdA)

Leaving the remediated portions of the TCdA and entering uncontrolled, unremediated areas is of concern, particularly for people already exposed to lead and other contaminants in their living environment. The frequency of such exposures is likely low, so the potential for health concern from these exposures alone is also low. However, all users are advised to remain on the trail. If direct contact exposure to media in unremediated areas does occur, the exposed area should be washed.

Persons performing maintenance on the TCdA should receive appropriate training on avoiding contact with and handling of hazardous wastes as well as on the proper protective equipment necessary to prevent or reduce exposures.

Community Health Concerns

In response to community health-related concerns, ATSDR has investigated potential associations between reported autoimmune diseases and metals of concern at the CdA River Basin site. Although a number of studies investigate this possible relationship, most are based on animal research. The literature shows some evidence for immunological disruption by some metals, but none reports an association with the specific diseases identified as community concerns.

ATSDR and the Idaho Division of Health (IDH) jointly prepared a public health consultation to evaluate metals data reported for fish samples collected in 2002. A fish consumption advisory for Lake Coeur d'Alene was issued jointly by the State of Idaho and the Coeur d'Alene Tribe in 2003. ATSDR supported that advisory.

Fish

A sampling effort has been conducted to determine the level of metals contamination in fish commonly caught in Lake Coeur d'Alene. Worst-case exposures used maximum metal levels and subsistence fish consumption. Because of their greater consumption rates and the generally higher arsenic levels in gutted-carcass portions of certain often consumed fish (e.g., bullhead, bass, or kokanee), a public health hazard may exist for subsistence fish consumers. For those individuals who consume more than 540 g/day of contaminated fish, the risk increases proportionally.

As discussed in ATSDR's public health consultation on fish caught in Lake Coeur d'Alene (See Appendix I), estimated blood lead increases were highest for traditional subsistence consumers of bullhead gutted-carcass portions. A public health hazard may exist for adult traditional and contemporary subsistence consumers of bullhead gutted-carcass portions, especially from the center of the lake. A public health hazard may also exist for adult recreational consumers of gutted bullheads, especially those caught from the center of the lake, if they are exposed to lead through other pathways.

A conservative evaluation of child lead exposures indicates that bullhead gutted-carcass portions could push blood-lead levels above the CDC benchmark (10 µg/dL). Therefore, a public health hazard may exist for children eating bullhead gutted-carcass portions. A public health hazard also may exist for children under 12 years of age with elevated blood-lead levels who eat 170 grams (6 ounces) per day or more of gutted bass, kokanee portions, or bullhead fillets. A portion size is defined as 227 grams (8 ounces) of fish per meal for adults and 114 grams (4 ounces) per meal for children.

Conservative exposure dose estimates for traditional and contemporary subsistence fish consumers indicate the possibility of elevated exposures and adverse effects from mercury. Thus, a public health hazard may exist for pregnant women, women of childbearing age, young children, and adults who are subsistence fish consumers. A public health hazard also may exist for children under 15 years of age who eat more than 65 grams (2 ounces) of fish per day.

9.1.2. Exposures of Concern to Recreational Users with Residential Exposures

Lake Coeur d'Alene

The data shows that, aside from the potential hazards from eating aquatic biota described below, recreating at Lake Coeur d'Alene represents *no apparent public health hazard*. ATSDR estimated exposure doses for acute and intermediate exposure durations for persons exposed recreationally to surface waters and sediments. The estimated exposure doses for these recreational users—in this case, those who have no residential exposures—do not exceed levels known to cause adverse health effects. Therefore, ATSDR does not expect negative health effects to result in individuals from recreational activities at CUAs along Lake CdA. However, all recreational users should as a precaution, thoroughly wash hands and other areas of direct contact exposure.

Studies of bullhead, bass, and kokanee taken from Lake Coeur d'Alene indicate that increases in estimated blood lead are lowest for non-resident, recreational consumers of bullhead gutted-carcass portions. A conservative evaluation of child lead exposures, however, indicates that eating bullhead gutted-carcass portions may push a child's blood-lead levels above the CDC benchmark (10 µg/dL). Therefore, a public health hazard may exist for children under 12 years of age who a) already have elevated blood-lead levels and b) who eat 170 grams (6 ounces) per day or more of gutted bass or kokanee portions or bullhead fillets. However visiting children are expected to consume fewer meals over a period of time than children who reside in the area. Therefore an annual exposure factor of one (365 days per year) was used for all residential exposure estimates and an annual exposure factor of 0.28 (104 days per year) was used for non-residential exposures.

In general, mercury is not thought to be a concern in the Basin. However, a public health hazard from mercury could exist for children under 15 years of age who eat more than 65 grams (2 ounces) of Lake Coeur d'Alene fish per day.

Spokane River

Except for sediments and aquatic biota as described below, exposures occurring intermittently and for short periods of time to metals in contaminated environmental media represent a no apparent public health hazard for recreational users along the Spokane River.

Sediments along the beaches and shorelines of the Spokane River may pose a public health hazard to residential and non-residential recreational users via ingestion, inhalation, and direct contact. Children are the population at greatest risk of adverse health effects (elevated blood levels) resulting in damage to the central nervous system. The concentration of lead in the sediments has resulted in the Spokane Regional Health District issuing a sediment contact health advisory.

Aquatic biota caught in some areas of the Spokane River, represent a public health hazard especially for children, pregnant women, and women who are considering pregnancy. The State of Washington has issued a public health advisory for fish caught in the Spokane River because of the presence of lead and PCBs.[25] ATSDR does not recommend the consumption of whole fish as lead concentrates in the bones. ATSDR is unable to determine if fish caught in other Basin water-bodies in Washington state would pose a public health hazard due to lack of sampling data.

9.1.3. Exposures of Concern to Practitioners of Subsistence Lifestyles

Using parameters outlined in EPA's HHRA, ATSDR evaluated the potential for exposure from living a subsistence lifestyle within the CdA River Basin and the resulting potential adverse health effects. Based on this evaluation, ATSDR concluded that if a person were to utilize contaminated resources in a manner consistent with a subsistence lifestyle, that person would be at increased risk for adverse health effects from increased body burden of lead. These adverse effects could include but are not limited to: elevated blood lead levels leading to behavior and learning problems, kidney damage, hypertension, damage to the central nervous system, growth retardation, and anemia.

9.2. Past Site Conditions and Exposures

Those areas of the CdA River Basin site close to the former smelter posed a *public health hazard in the past* because of elevated levels of particulate matter including lead, cadmium, and sulfur dioxide in ambient air. EPA reports that the site is now in compliance with air standards.

Based upon sampling data, lead and other concentrates which spilled from ore transport trains have contributed to contamination of the adjacent right-of-way.

The maximum concentration of lead detected in a groundwater sample taken from an Osburn residence in 1994 represented a public health hazard. The concentration was potentially high enough to cause neurological and hematological disorders in potentially affected individuals, especially children. Alternative potable water source is being used.

A community water system near Osburn was found to contain elevated concentrations of cadmium. The water was diluted with water from another system to bring it into compliance. Lead and copper have been detected in other water systems. This may be due to leaching from pipes and plumbing fixtures. These systems are receiving corrosion treatment.

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[25] Note: This contamination is not thought to be related to mining wastes.

9.3. Future Site Conditions and Exposures

A majority of the unremediated surface soils and subsurface soils in the CdA River Basin site are contaminated with metals. If these areas are developed into residential neighborhoods, the concentration of contaminants could pose a *public health hazard*.

9.4. Conclusions Based on Area Environmental Studies

1. Characterizing the exact nature and extent of surface soil contamination for a region as large as the CdA River Basin site is unrealistic. Although this PHA reviews the results of thousands of surface soil samples, the possibility remains that many highly contaminated areas have yet to be identified. Sampling within the site continues.

2. Contaminants—especially metals—from mining sites in the Silver Valley region have deposited on or in soils throughout the CdA River Basin site. Past atmospheric deposition, human transport of mining wastes, use of waste material to fill roadways, and sediment deposition account for the region's soil contamination. Soils near mining sites and in areas frequently submerged by floods appear to have the highest contamination levels.

3. CUA samples suggests that the highest surface soil contamination of lead, the contaminant of greatest concern for this site, exists in areas to the east of Lake Coeur d'Alene. Specifically, lead concentrations greater than 1,000 ppm were most frequently reported for CUAs along the CdA River and South Fork CdA River. No lead concentrations higher than 1,000 ppm were found in CUAs along Lake Coeur d'Alene, and lead concentrations higher than this occurred only infrequently along the Spokane River. This trend should not be regarded as conclusive, however: it may reflect the actual spatial distribution of contamination, but it also may reflect the limited number of sampling locations within each region. ATSDR does note however, that elevated concentrations of lead and arsenic were detected in soil and sediment samples taken from Harrison Beach in the past. These media were remediated as part of a removal action for the UPRR.

4. In the past, some regulated water systems had documented elevated concentrations of some metals. The contamination has been addressed through a number of methods. To more accurately predict potential health effects, additional sampling data (including location) from private and public drinking water supplies throughout the CdA River Basin[26] are necessary.

5. Not all private wells have been characterized.

6. The extent of surface water contamination varies from location to location in the CdA River Basin. It has also varied from year to year. Proximity to mining sites, river

[26] These data are needed in addition to those used in a 2000 ATSDR public health consultation on Basin-wide residential properties sampled under Field Sampling Plan Addendum 06 (FSPA06) (ATSDR 2000a).

flow conditions, and many other factors affect contamination levels at any given place and time. Metals contamination in sediments throughout the region continues to be a source of surface water contamination, as demonstrated by the high surface water concentrations of metals detected when nearby sediments are disturbed.

7. Metals contamination of sediments is widespread in the CdA River Basin. Elevated metals concentrations have been detected in surface sediments in areas ranging from the mining sites near the headwaters of the tributaries to the South Fork CdA River to downstream stretches of the Spokane River. In some locations, metals-laden sediments are several feet thick. Sediment contamination downstream will continue to increase as long as metals remaining in upstream sediments are being transported downstream.

8. Metals found at elevated levels in the sediments of the CdA River Basin are found in the tissues of many fish and shellfish throughout the basin (Johnson et. al. 1994, Johnson 1994 and 2000). Fish and shellfish in the CdA River Basin generally have higher levels of contamination than fish and shellfish caught in surface waters in northern Idaho unaffected by the Silver Valley mining wastes.

9. The ambient air concentrations of particulate matter (PM) near the Bunker Hill site have improved considerably over the last 30 years. The available data indicate that both maximum and average concentrations of TSP exceeded EPA's former standard almost every year during the 1970s at locations throughout the Box. The data also show that average or maximum TSP concentrations in some communities outside the Box — Cataldo, Kingston, Mullan, Osburn, and Wallace — also exceeded EPA's former standards during the 1970s.

10. EPA currently classifies all of Shoshone County as being in compliance with its air quality standard for lead and sulfur dioxide.

11. A few studies on crayfish have characterized the levels of contamination in shellfish in the CdA River Basin, but so far no statistics-based study has addressed the nature and extent of metals contamination in the area fish and shellfish people prefer to eat. Carefully planned future studies will provide greater insight into potential exposures and may verify exposure point concentrations.

12. Virtually every avian and mammalian species sampled in the CdA River Basin has been found to have metals contamination in tissues and fluids that most people do not eat: kidneys, liver, bones, and blood. Information on levels of contamination in muscle tissues from wildlife is very limited. The most extensive and most recent study of contamination in breast tissue of ducks suggests that cadmium and lead are rarely found at detectable levels in these tissues, even when they are found at elevated levels in the kidney, liver, and bone.

    When detected in the breast tissue, the metals were never found at levels higher than 0.1 ppm (cadmium) and 1.6 ppm (lead), respectively. Other studies, though limited in the number of waterfowl samples analyzed for muscle tissue contamination, report comparable cadmium and lead concentrations. These limited data for ducks, however, do not adequately support a quantitative evaluation of human exposure to contaminants in all wildlife species.

13. CdA River Basin residents who consume water potatoes reportedly harvest them only from relatively uncontaminated areas in the St. Joe River basin. Recent sampling data confirm that water potatoes in the St. Joe River basin have low levels of metals contamination, with cadmium and lead not being detected in any of 50 water potato samples from this region.

    Water potatoes along the CdA River and in the lateral lakes, however, contain elevated concentrations of several metals, especially in the skins. The average concentrations of cadmium and lead in the unskinned samples from the CdA River Basin, for example, are 0.39 and 30 ppm (on a wet-weight basis), respectively. Residents should avoid consumption of water potatoes grown in the CdA River Basin because of the elevated metals concentrations. By all accounts, residents do not frequently (if ever) consume water potatoes from the CdA River Basin, partly because of concerns about the known contamination in this region.

14. Though sampling data for other wild plants that residents might consume, such as wild rice and berries, are extremely limited, the available data confirm the presence of metals contamination in various species that grow in the CdA River Basin. A food consumption survey of tribe members and licensed fishers indicated that roughly 5% of these residents consume locally harvested wild rice once or more per week. The survey did not, however, ask residents exactly where they obtained the wild rice they ate.

10. RECOMMENDATIONS

During the PHA process, ATSDR makes recommendations about public health actions that the agency believes should be conducted at a hazardous waste site or in the community. These recommendations may be directed to other agencies or to ATSDR itself. In developing these recommendations, ATSDR consults with other agencies to ensure that someone is available to follow up on these recommendations, where appropriate. Following are ATSDR's recommendations for the CdA River Basin site.

10.1. Actions to Cease or Reduce Exposures

- Provide children access to play areas that do not have elevated metal levels in soil.
- Remediate residential properties on the site which house highly susceptible populations in order to eliminate and to prevent exposures to populations of concern. Health education alone cannot be relied upon for long-term solutions.
- Persons at risk of multiple exposure sources for lead should try to eliminate as much exposure to lead as possible.
- Persons living in residences with elevated concentrations of lead and other metals in household dust and surface soils should clean their homes regularly to reduce buildup of the contaminated media inside of their homes.
- Care should be taken to maintain properly the paint in homes constructed prior to 1978. Also, regular physical examination of painted surfaces should be performed to identify early signs of deterioration.
- Residents and non-resident recreational users should follow the State of Idaho and Coeur d'Alene Tribe's fish consumption advisory for Lake Coeur d'Alene.
- Highly susceptible populations, such as children and pregnant women, should avoid ingestion of contaminated fish and produce grown in contaminated soils.
- The number of fish meals consumed of aquatic biota taken from Lake Coeur d'Alene should be limited. ATSDR does not recommend consumption of whole fish as lead concentrates in bone tissue.
- Residents who must face multiple sources of metals exposure should eliminate or drastically decrease their consumption of locally caught fish or shellfish. Taking this precaution will reduce their chances of developing adverse health effects caused by cumulative exposure to individual metals.
- People whose homes have elevated levels of contaminants in soil and dust—or who have other sources of exposure, such as consuming fish—should exercise caution when recreating in CUAs in the CdA River Basin.
- All persons, especially children, should avoid prolonged contact with the contaminated media and use proper hygienic methods to avoid incidental ingestion of the contaminated media.
- Residents and non-resident recreational users exposed via skin contact to contaminated soil, surface waters, and sediments should thoroughly wash the exposed area.

- Signage along the 73-mile TCdA should be increased. Access to and from contaminated environmental media onto the trail should be restricted.
- Persons who are potentially exposed to metals in their normal living environment should stay on the trail to reduce risk of additional exposure to contaminants in media in close proximity to the TCdA.
- Although it is desired by many Tribal members, the return to the traditional subsistence lifestyle would not be advised for the foreseeable future. This is due to the level of contamination in various media within the CdA River Basin. Actions should be taken to reduce/eliminate contamination of natural Basin resources.
- The current sediment contact health advisory for the Spokane River (Washington State) should remain in place for the affected CUA. The advisory should recommend simple ways to limit contact with contaminated sediments at the River Road 95 CUA.
- Eliminate or limit exposure to contaminated sediments for local and non-local residents who visit the shoreline and beach CUAs of the Spokane River for recreational purposes.
- Some species of Spokane River fish such as large scale suckers caught between Upriver Dam and the Washington/Idaho state line and rainbow trout, mountain whitefish, and large scale suckers caught below Upriver Dam to Nine Mile Dam, should be consumed only occasionally (one meal or less per month); some such as rainbow trout and mountain whitefish caught between Upriver Dam and the Washington/Idaho state line should not be eaten at all.

10.2. Actions for Site Characterization

- Test surface soils and household dust of properties throughout CdA River Basin site where highly susceptible populations reside in order to characterize the extent of contamination.
- Monitor remediated media near source areas following flood events to see if recontamination has occurred.
- Conduct a survey of local residents to determine the source of their potable water supplies. Users of water supplies shown to be contaminated with metals at concentrations above health-based standards should be provided an alternate water source or provided information on bringing their water into compliance with safe drinking water standards.
- Persons who take water from any non-regulated source should have the water tested.

10.3. Recommendations for Health Activities

- ATSDR strongly recommends continued educational and remedial activities throughout the CdA River Basin.
- Continue to make blood lead monitoring available to area children. Perform follow up as appropriate.
- Continue to provide information to residents and recreational users on the hazards of lead ingestion until soils are remediated. The Panhandle Health District’s Lead Health Intervention Program and others information should include instruction on

avoidance of these hazards and hygiene methods to prevent/mitigate additional exposures.

- Extend the Bunker Hill Institutional Controls Program to include the CdA River Basin site.
- Provide all maintenance workers hazard recognition and safety training to prevent taking contaminants home.
- Provide appropriate training to persons performing maintenance on the TCdA on avoiding contact with and handling of hazardous wastes as well as on the proper protective equipment necessary to prevent or reduce exposures.
- Review additional environmental data, including surface water and biota data as appropriate, to determine possible health implications.
- Monitor ambient air quality at those locations where remediation and construction activities involve soil excavation or removal and employ dust suppression techniques to minimize the release of dusts during remediation activities.

11. PUBLIC HEALTH ACTION PLAN

The purpose of the public health action plan is to ensure that this PHA not only identifies ATSDR's past activities at this site but also provides a course of action for mitigating or preventing exposures that may cause adverse human health effects.

11.1. Actions Completed or Ongoing at the Site

1. ATSDR has conducted public availability sessions within selected communities of the CdA River Basin site in an effort to gather the communities' health related concerns. In addition, ATSDR has met with various community leaders regarding conditions and health concerns within the Basin. ATSDR has also attended EPA's public availability sessions and public meetings. Representatives from ATSDR's Region 10 Office regularly attend meetings with groups organized to address environmental concerns at the site.

2. During the summer of 1996, ATSDR funded an environmental health exposure assessment conducted by the Division of Health, Idaho Department of Health and Welfare, in cooperation with the Panhandle Health District.

3. ATSDR has funded blood-lead testing and intervention activities in the CdA River Basin.

4. In March 2000, ATSDR issued a public health consultation on Basin CUAs. This document provided comments to EPA on early contamination removal and intervention strategies. It also concluded that the proposed early action levels for antimony, arsenic, cadmium, and lead might not provide adequate protection for area residents. ATSDR determined that area non-resident recreational users who use CUAs should not experience any adverse health effects from metals at concentrations below the proposed early action levels. The consultation recommended that residents be notified of the hazards they may encounter during recreational activities at CUAs.

5. In May 2000, ATSDR issued a public health consultation on the Basin-wide residential properties sampled under Field Sampling Plan Addendum 06. ATSDR evaluated the health threat posed to children by lead contamination in soil, indoor dust, and water by
   - Calculating an estimated daily intake rate and comparison to an intake of concern for the population;
   - Estimating expected blood-lead levels through EPA's Integrated Exposure Uptake Biokinetic Model for Lead; and
   - Estimating blood-lead levels through an ATSDR-integrated exposure regression analysis model for use at lead sites. ATSDR concluded that a public health hazard could exist for children living in more than half of the residences sampled and recommended reducing or ceasing exposures to contaminated soils and dusts.

The consultation also recommended medical surveillance and monitoring of children with elevated blood-lead levels.

6. In June 2003, ATSDR issued a draft of the present PHA to peer reviewers outside ATSDR. The purpose of this review was to ensure the highest scientific quality. ATSDR received comments from the peer reviewers in August 2003 and incorporated these into this document.

7. In September 2003, ATSDR issued a public health consultation on fish in Lake Coeur d'Alene. The consultation evaluated data from bullhead, bass, and kokanee caught in the lake (see Appendix I).

8. ATSDR continues to address issues regarding the site as they emerge.

11.2. Actions Planned for the Site

1. ATSDR and CDC's National Center for Environmental Health (NCEH) will assist the Basin Environmental Project Improvement Commission, IDEQ, IDH, PHD, and EPA to plan an appropriate blood-lead monitoring program for young children in high risk areas for lead poisoning and other environmental contaminants.

   The ideal program would integrate a blood-lead monitoring program that strengthens the infrastructure and capacity of the area's overall remedial, housing, and public health activities. Examples of local partnerships may include the following programs: Women and Infant Care, MEDICAID (Early Period Screening, Diagnostic, and Treatment), Immunization, and Early Head Start.

2. Health education activities for the Bunker Hill OU3 (Coeur d'Alene River Basin site) are being conducted by the Idaho Department of Public Health, Bureau of Community and Health Education through a cooperative agreement with ATSDR. The Bureau of Community and Health Education has already conducted numerous presentations in elementary and secondary schools regarding lead and its health effects in addition to discussions about CdA as a superfund site. The Bureau of Community and Health Education will work closely with the Panhandle Health District, non-profit agencies, ATSDR and other federal and state agencies in providing additional health education activities as needed/requested by the community.

3. To address health concerns of the CdA River Basin community, ATSDR's Division of Health Studies (DHS) will work with the state and local health departments as needed to review relevant health outcome data.

4. ATSDR will evaluate additional relevant site data for potential impacts on CdA River Basin populations, if requested.

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APPENDICES

Appendix A–Figures

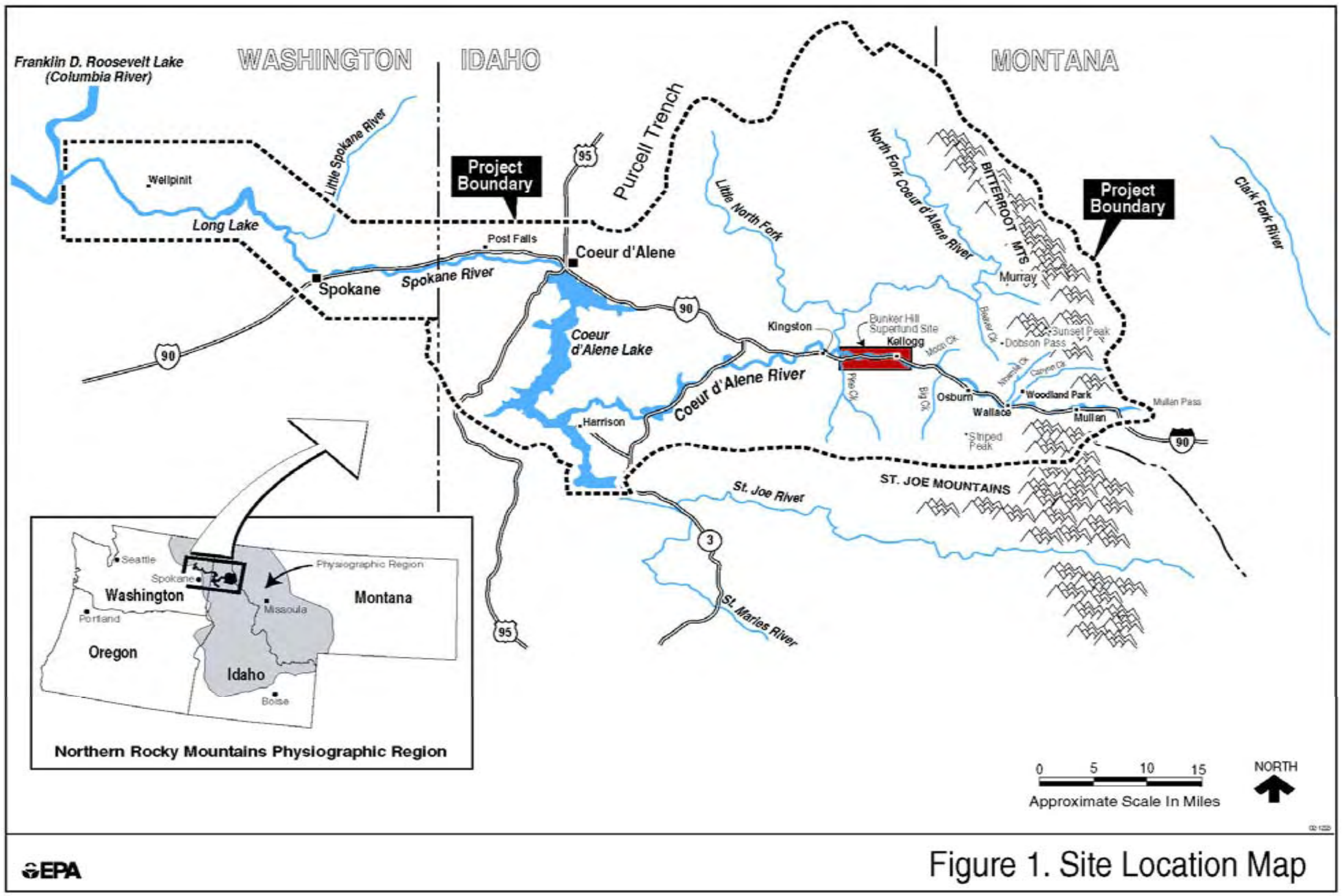

Figure 1 - Site Location Map

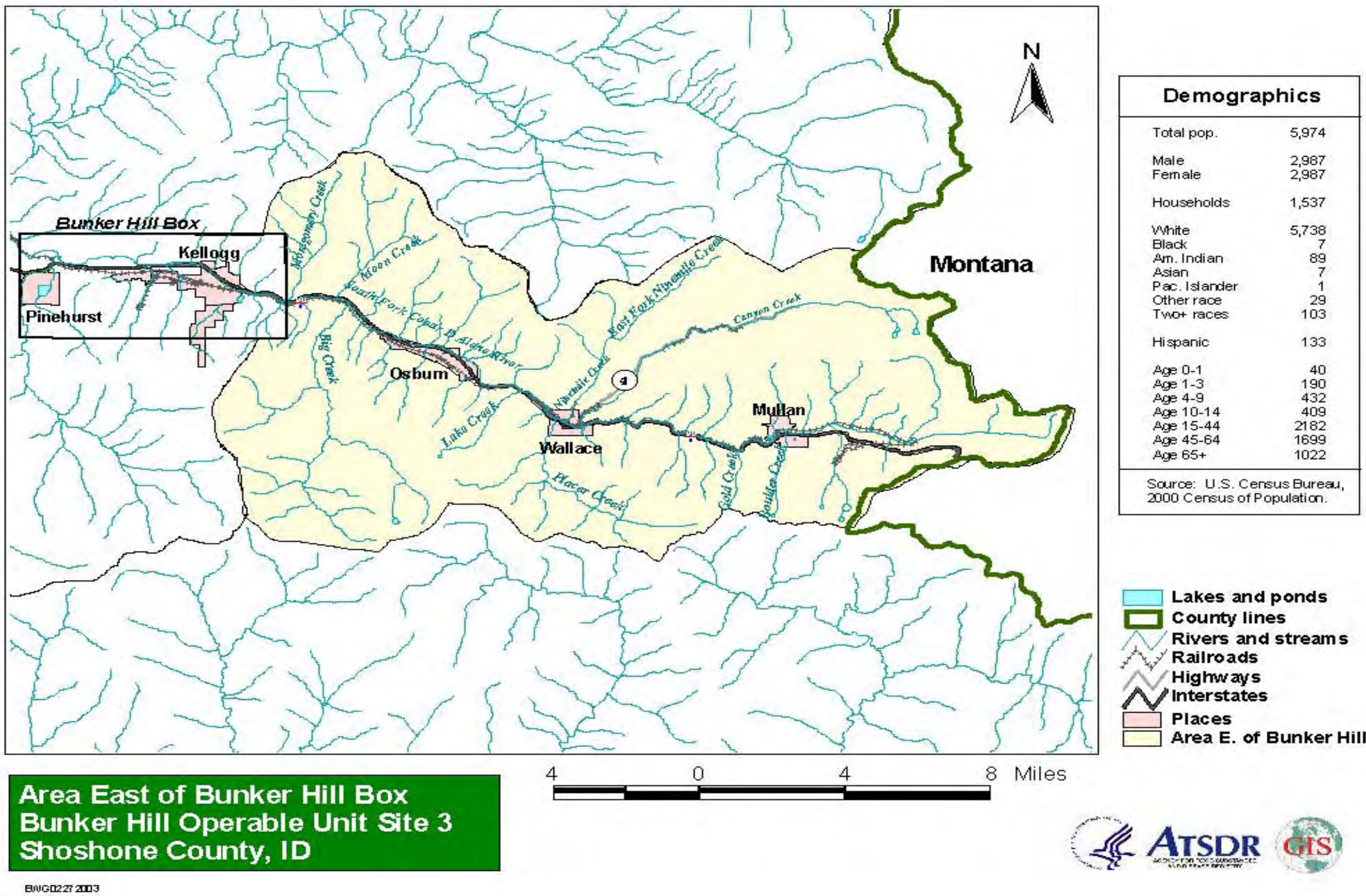

Figure 2 - Area East of Bunker Hill Box

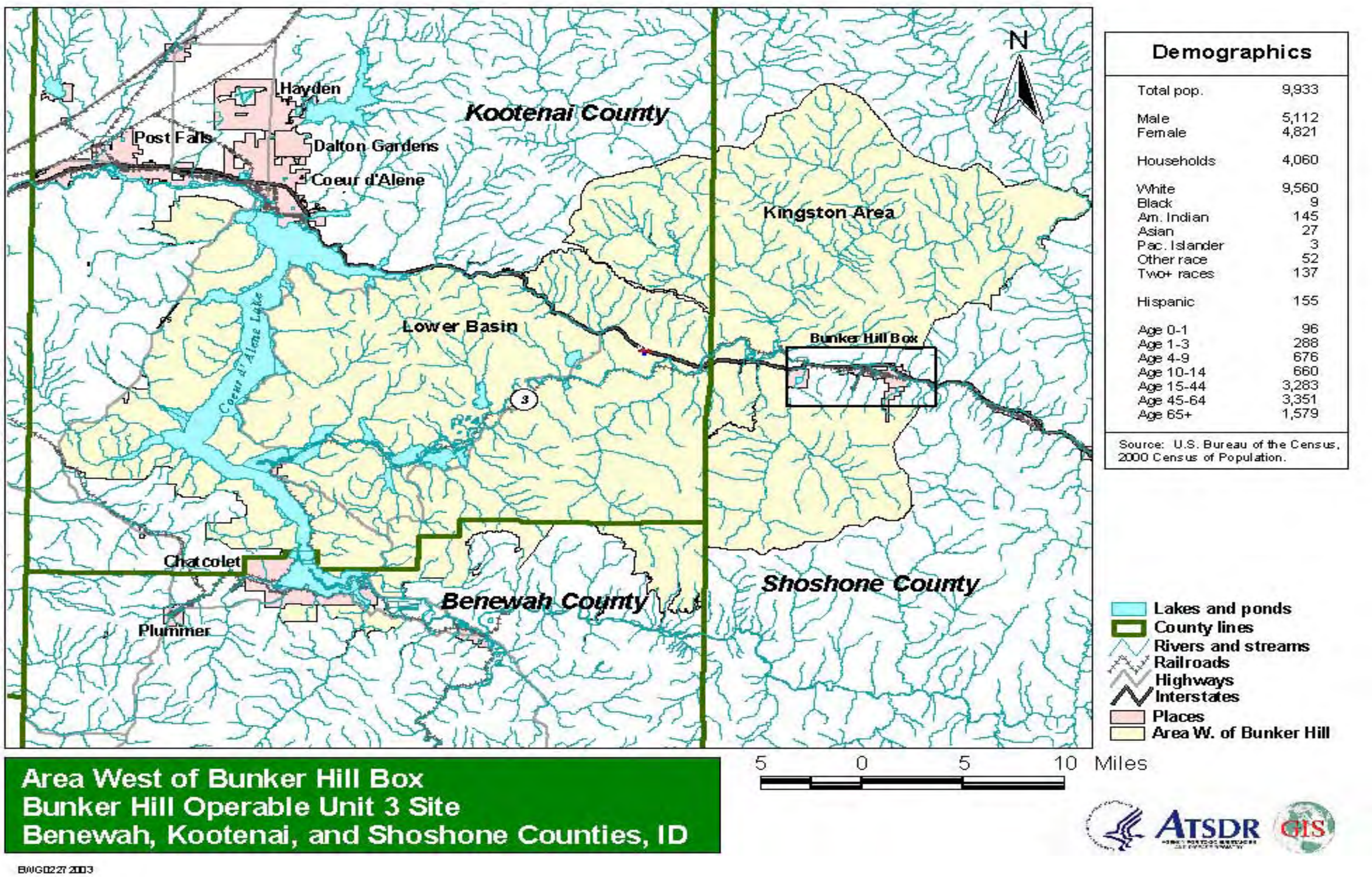

Figure 3 - Area West of Bunker Hill Box

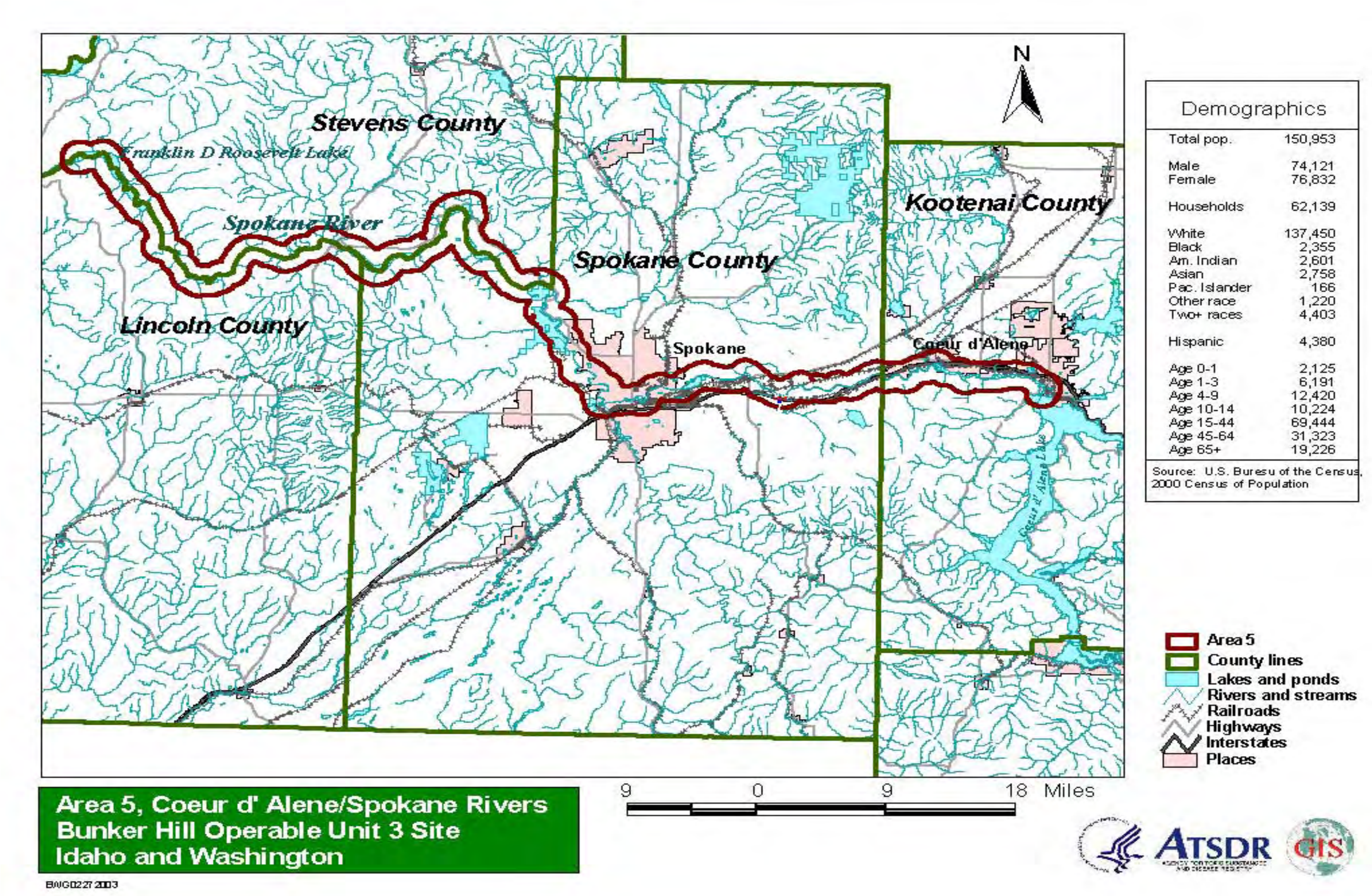

Figure 4 - Area 5, Coeur d'Alene/Spokane Rivers

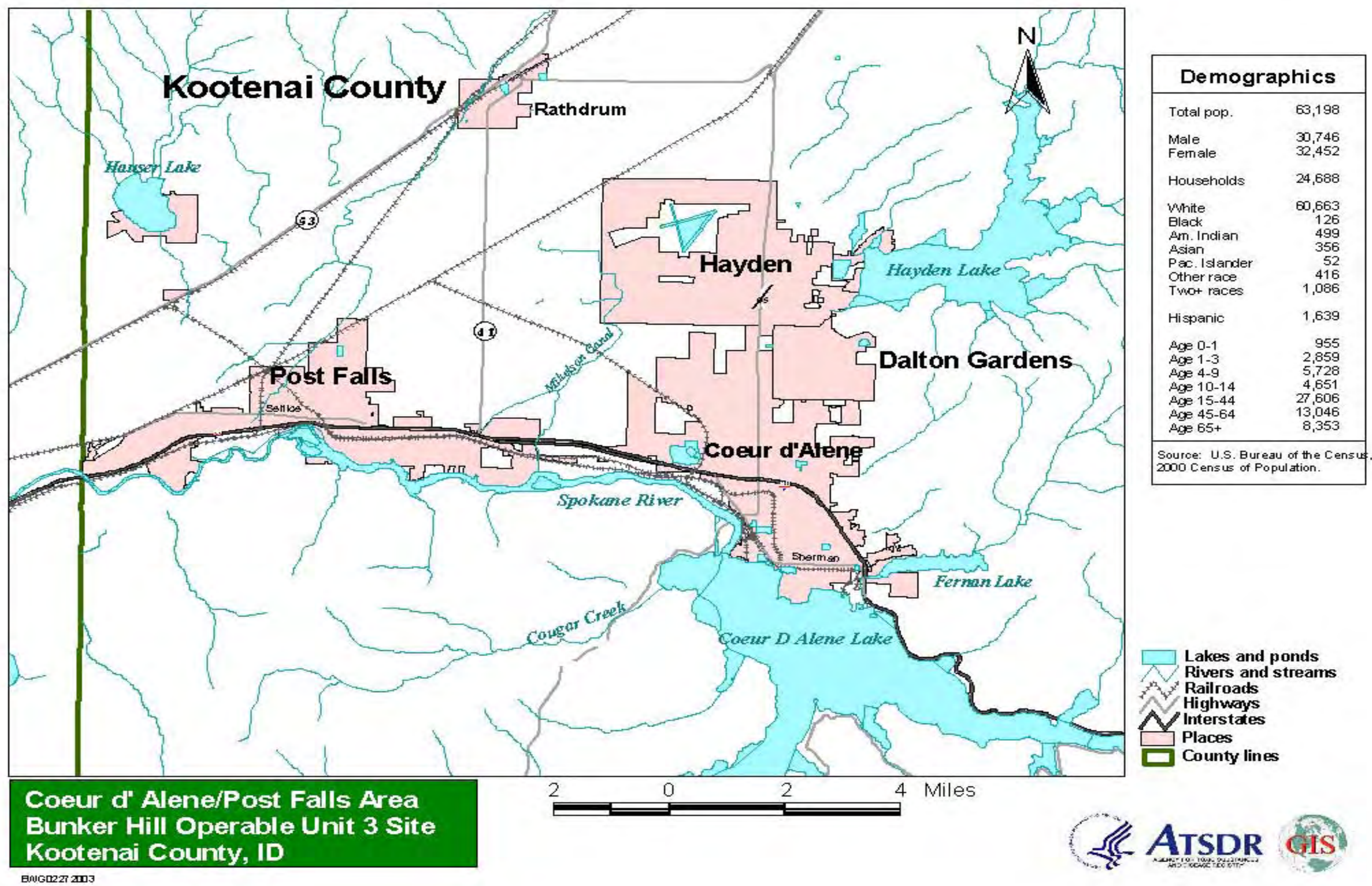

Figure 5- Coeur d'Alene/Post Falls Area

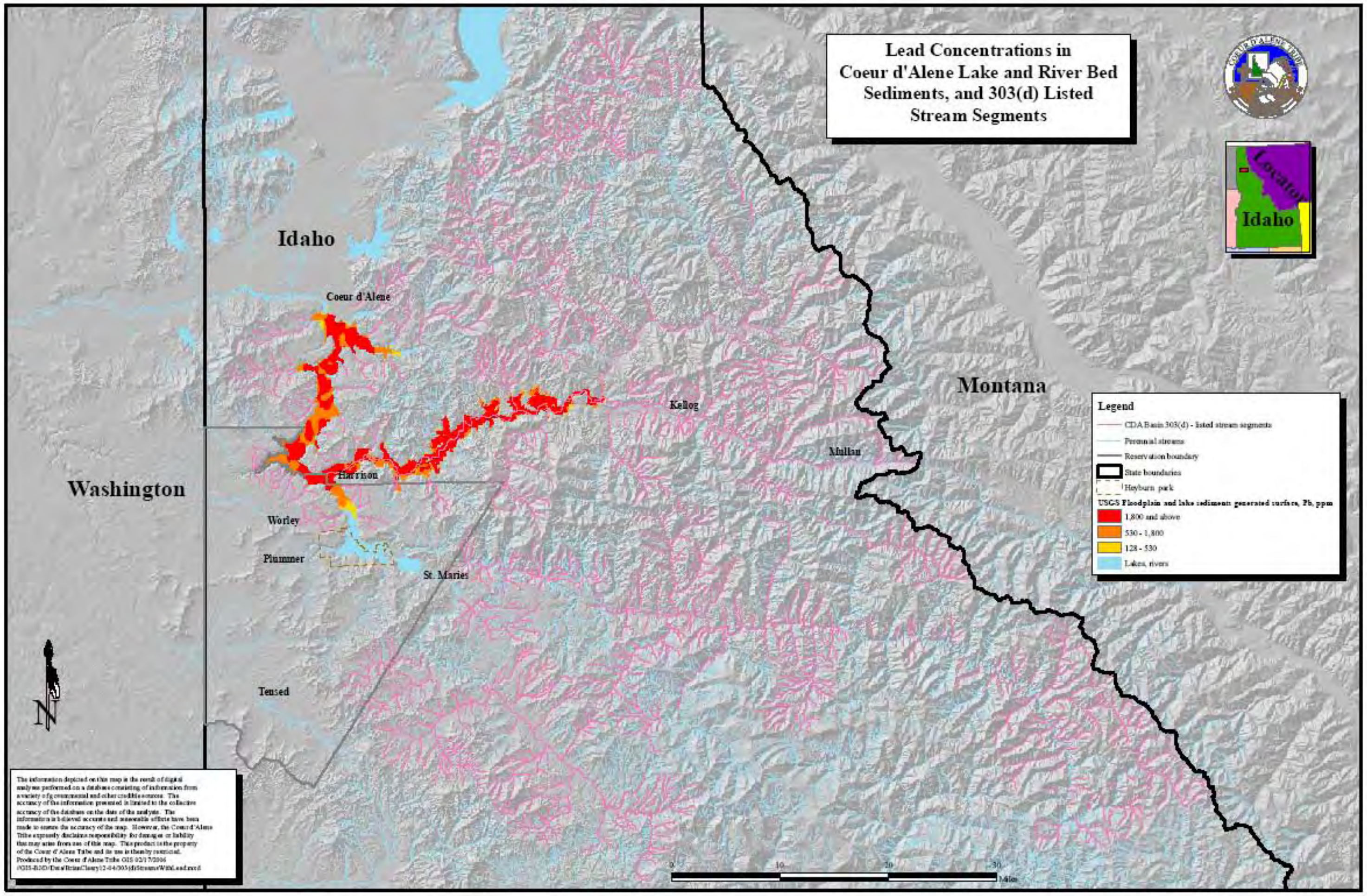

Figure 6 – Lead Concentrations in Lake CdA and Riverbed sediments

Figure 7 - Example of Posting along the Trail of the Coeur d'Alenes

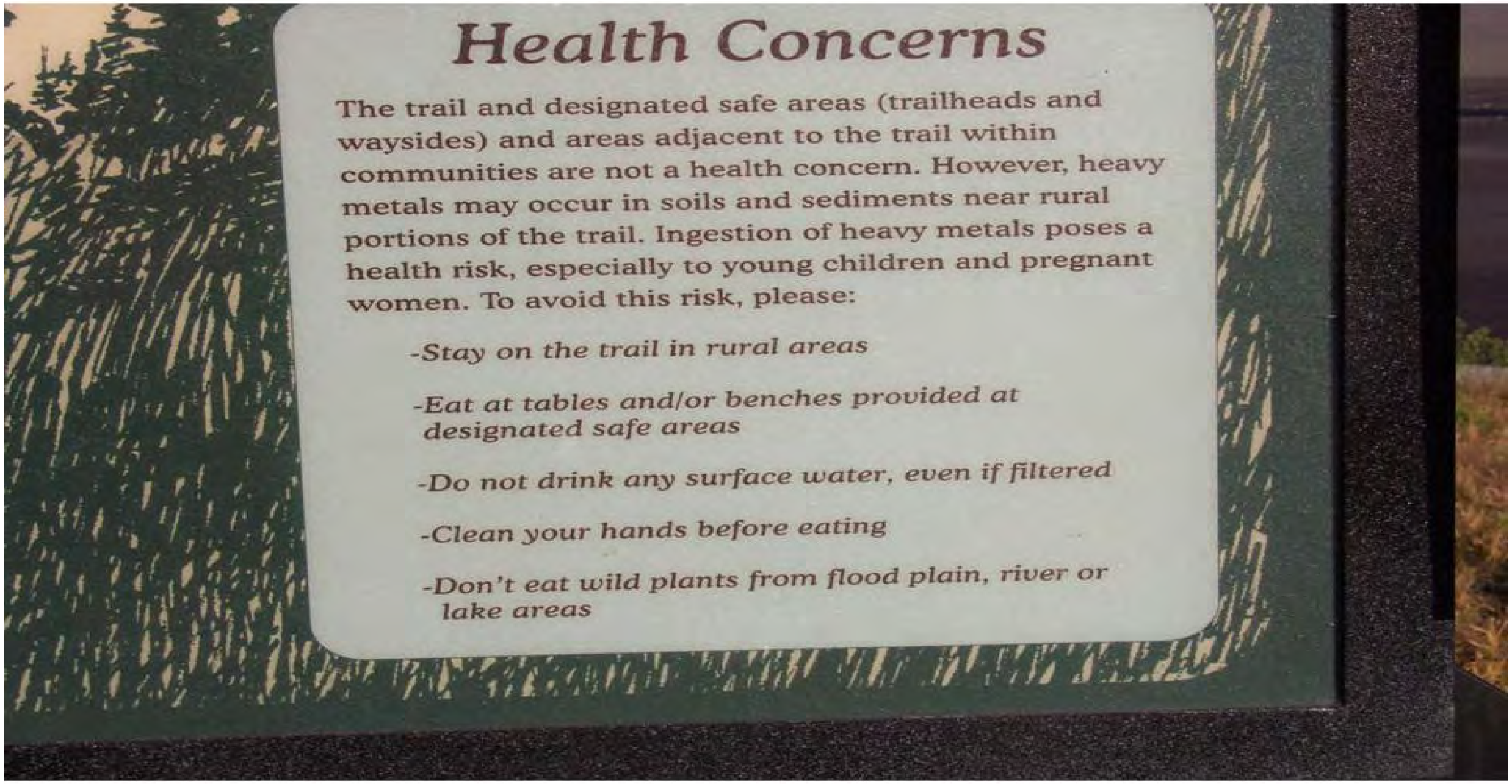

Figure 8 - Example of health warning posted along the Trail of the Coeur d'Alenes

Figure 9 - Example of precautions taken to reduce exposure to metals in the vicinity of the Trail of the Coeur d'Alenes

Appendix B–Site Investigations

Site Investigations

The environmental investigations conducted by EPA Region X, state and local environmental departments, their contractors, or a combination thereof, have identified various contaminants in local media such as surface soil, groundwater, surface water, and sediments. This part of the public health assessment will discuss the environmental investigations used to characterize contamination at the CdA River Basin site. Those contaminants detected above screening values or above normal background levels in the residential and non-residential environmental media are summarized. Missing and inconsistent data are discussed in the data gaps subsection.

B.1. Surface Soil

B.1.1. Residential Surface Soil

Between July 1998 and March 2000, residential surface soil samples from east of the Bunker Hill Superfund site were collected as part of EPA's field sampling plan (see Table C1). The URS database (URS 2000) included more than 2,200 records. Samples were collected from yards, driveways, play areas, gardens, downspouts, and other discrete areas. The data indicate that several locations in Wallace (and other locations) contain elevated levels of certain metals. Several metals have at least one concentration higher than their corresponding screening value. A subset of these metals (including arsenic, cadmium, lead, and zinc) have numerous concentrations more than one order of magnitude higher than the screening value. The maximum concentration of arsenic was found in samples collected from a driveway in Wallace. The concentration of arsenic in play area soil was as high as 1,480 milligrams per kilogram (mg/kg) soil. In a sample taken from a driveway in Nichols Gulch, lead was detected at its maximum concentration. The highest concentration of lead in soil identified as coming from a play area was 3,390 mg/kg, from a sample collected in Wallace.

ATSDR reviewed over 200 sampling records (URS 2000) of residential surface soil samples collected west of the Bunker Hill Superfund site during the period July, 1998 through March, 2000. The results of the review are summarized in **Table C2**. Samples were collected from downspouts, driveways, gardens, play areas, yards, and other discrete areas. The data indicate that surface soils in Kingston and Cataldo contain elevated levels of certain metals. Several of the metals have at least one concentration higher than their corresponding screening value, including arsenic (142 mg/kg), lead (13,200 mg/kg), and manganese (9,790 mg/kg). The highest concentrations of most of the metals (excluding arsenic and mercury) were found in samples collected in Kingston. The concentration of these contaminants and others in soil samples taken from residential areas within the CdA community were significantly lower (arsenic 17.9 mg/kg, lead 62.1 mg/kg, and manganese 1,310 mg/kg) than the levels detected in Kingston and Cataldo.

B.1.2. Surface Soil Samples from Schools and Daycares

From August 1999 to March 2000, surface soil samples were collected in areas surrounding daycares and schools in Mullan, Osburn, and Wallace. ATSDR reviewed over 220 sampling records. In a sample taken in Mullan school play areas, lead was found at a maximum concentration of 11,900 mg/kg. The highest concentration of arsenic (742 mg/kg) was detected in a sample taken from an undisclosed location in Osburn (**Table C3**). The contaminated soils at the Huggy Bear Day Care Center in Silverton have been remediated.

Surface soil samples west of the Bunker Hill Superfund site were collected from areas surrounding schools and daycares in Kingston and Cataldo. The sampling took place from August, 1999 to March, 2000. ATSDR reviewed nearly 100 sampling records. The data are summarized in **Table C4**. The maximum concentration of lead detected west of the Bunker Hill Superfund site was 171 mg/kg collected from an elementary school play area in Cataldo. This maximum concentration is less than the current soil screening level for lead (400 mg/kg). A sample collected in the CdA community contained lead at a maximum concentration of 576 mg/kg. This concentration is slightly above the soil screening level for lead.

B.1.3. Surface Soil Samples from Common Use Areas

Surface soil samples were collected from CUAs in the Side Gulches, Silverton, and Wallace subareas. **Table C5** summarizes the collected sampling data. Surface soil concentrations of 13 metals exceeded their corresponding screening value in at least one sample collected. In the Elk Creek area of Side Gulches, only antimony, arsenic, copper, lead, and mercury were found in excess of one soil concentration more than 10 times the screening value. Though these elevated contamination levels were found in an area frequent by residents, ATSDR notes that the durations of exposure to the contaminants at the concentrations shown are probably shorter than those for the contaminants found in residential soils. The exact duration of exposure to soils in the CUAs, however, is not known. The data indicate that surface soils in CUAs throughout Silverton and Wallace contain elevated levels of several metals. Five of these metals—antimony, arsenic, copper, lead, and zinc—have more than one concentration at least 10 times higher than the corresponding screening value. The frequency and duration of exposure at these various CUAs in Silverton and Wallace must be considered when interpreting these results.

In the human health risk assessment the town of Osburn is designated as “Area 6" (TerraGraphics 2000); however, no surface soil sampling data are reported in that risk assessment or in companion volumes (URS 1999) for that area. The absence of sampling data apparently results from the fact that no CUAs were identified for the town of Osburn. Two studies (IDHW 1976 and MFG 1996) were found which reported the levels of contaminants in Osburn surface soils. Using a study completed in the 1970s (IDHW 1976) the “area averages” of lead and cadmium surface soil concentrations in Osburn were 1,775 mg/kg and 16 mg/kg, respectively. The study also indicates that soil lead concentrations at “Osburn school swings,” “Osburn Grade School,” and the “Osburn Radio Station” range from 130 mg/kg to 950 mg/kg. The second study was conducted in 1996 (MFG 1996) and reports the results of limited surface soil sampling in Osburn. The results indicate that samples collected at industrial locations were rich in metals, with lead, zinc, and cadmium concentrations as high as 49,800 mg/kg, 30,100 mg/kg, and 292 mg/kg, respectively. Samples collected at a residence, on the other hand, had low concentrations of metals, with average lead and zinc levels of 45.8 mg/kg and 39.7 mg/kg, respectively. ATSDR notes that these residential samples were not collected at the surface, and the contamination levels therefore are not representative of potential exposure point concentrations.[27]

Table C6 includes the results of sampling conducted at CUAs west of the Bunker Hill Superfund site. This area includes the CUAs along the Spokane River. These are the most extensively sampled areas within the Basin, with more than 3,300 soil sampling records available for CUAs. The maximum concentrations of metals (with the exception of aluminum) were detected in the region designated as the Lower Basin. Several of the metals—arsenic, lead, vanadium, and zinc—were detected at concentrations more than 10 times their respective screening values; this is a trend similar to that seen in non-CUAs in the area. The highest concentration of aluminum was detected in the floodplain soils along the Spokane River. The levels of contamination observed along the Spokane River likely originate from many sources, including the Silver Valley mining wastes, and from various discharges from municipalities and industries along the Spokane River and its tributaries.

Only the northern portions of Lake Coeur d’Alene (i.e., locations north of the mouth of the CdA River) have been extensively sampled. Specifically, the URS database includes surface soil sampling data only for upland areas at the following CUAs around the lake: Bell Bay, Cougar Bay, Loffs Bay, Mica Bay, Rockford Bay, and Windy Bay. It is unlikely that these are the most extensively used areas of the lake. General summary statistics for Lake Coeur d’Alene and other locations west of the Bunker Hill Superfund site are presented in **Table C6**. Statistical trends were noted when reviewing the data for Lake Coeur d’Alene:

- Consistent with findings from all other areas, contamination levels in the surface soils at selected locations around Lake Coeur d’Alene exceed screening values for several metals.
- The soil concentrations of lead—arguably the contaminant of greatest concern for this site—are relatively low, with the highest concentration (408 mg/kg) being only marginally higher than EPA’s residential soil screening level. At other basin locations, surface soil concentrations of lead are frequently higher than 1,000 mg/kg (EPA’s screening level for non-residential soil).

[27] The referenced documents were not listed in the URS database.

- Of the many metals considered in the sampling, only arsenic had at least one concentration more than 10 times higher than the corresponding screening value.

In addition to the data reported for the CUAs, ATSDR's contractors identified another source of data for Lake Coeur d'Alene: a 1997 study of lead contamination at beaches by the Panhandle Health District (PHD 1997). During this study, the health district collected "soils" from within 1 foot of the waterline at five beaches around Lake Coeur d'Alene: North Idaho College Beach, CdA Beach at the city park, Sanders Beach, Kid Island Bay Boat Launch, and Harrison Beach. Samples were apparently only analyzed for lead, and the measured concentrations ranged from not detectable (at 10 mg/kg) to 344 mg/kg. These results are qualitatively consistent with other sampling results reported for the Harrison and Lake Coeur d'Alene areas in that nearly every lead concentration measured did not exceed EPA's soil screening level.

Data on surface soils in Harrison appear to be limited to sampling conducted at upland areas of Harrison Beach, a CUA that faces west over Lake Coeur d'Alene. The surface soil samples collected near this beach had several metals with elevated concentrations. Still, the contamination levels appear to be somewhat lower than those reported for CUAs sampled in other parts of the Basin. Most notably, all lead and zinc concentrations measured in soils upland from Harrison Beach were lower than 100 mg/kg and 120 mg/kg, respectively—both considerably lower than levels measured at all other locations in the Basin. ATSDR cautions, however, about drawing conclusions from the Harrison Beach area. More extensive sampling would be needed to verify whether the soils in these upland areas are indeed less contaminated than other floodplain soils in the CdA River Basin.

B.1.4. Surface Soil Samples from Vicinity of Mining Sites and Waste Sites

The URS database (URS 2000) includes more than 1,900 surface soil sampling records for areas east of the Bunker Hill Superfund site. Most were collected at waste sites and in areas in the vicinity of former mining sites. Some of the sites sampled include the Mullan Waste Pile (also referred to as the Mullan Landfill), the tailings pile, and other wastes at the Golconda Mine site, the Rex mine, the Tiger-Poorman mine, the Charles Dickens mine, the Wolfson mine, and other locations. Several metals have at least one concentration higher than their corresponding screening value. A subset of these metals (antimony, arsenic, cadmium, iron, lead, vanadium, and zinc) contains numerous concentrations more than 10 times higher than the screening values. It is stressed that surface soil samples collected at these locations are from places where local residents and trespassers are not expected to frequent. As a result, residents probably are rarely, if ever, exposed to the levels of contamination shown in **Table C7**.

ATSDR reviewed the sampling records of surface soil samples collected from non-CUAs west of the Bunker Hill Superfund site (from the town of Kingston to the town of Harrison) including locations along the Spokane River in Washington. Most of the samples were collected in the region known as the Lower Basin. **Table C8** shows that at least 10 metals exceeded their screening values for soil ingestion. Of these, half (i.e., antimony, arsenic, copper, lead, and zinc) had several concentrations notably higher than 10 times their screening value.

B.2. Groundwater

B.2.1. Residential Groundwater Samples

In 1994, a consulting company conducted environmental sampling in an area of the CdA River Basin designated as “Osburn Flats,” defined as locations along the South Fork CdA River between the towns of Wallace and the point where Big Creek flows into the river. The sampling results, together with a selective review of previous sampling in the area, are documented in a 1996 report (MFG 1996). **Table C9** summarizes the results of the 1994 groundwater sampling conducted in Osburn Flats, with data presented for residential wells separate from data for other wells.[28]

Cadmium was detected in 7 out of 11 groundwater wells sampled, and every detected concentration was higher than the screening value for drinking water exposures. Two of the samples with cadmium detections were from residential wells. Similarly, lead was detected in 2 of 11 groundwater samples, one at a residence and one at a school. Both detections exceed EPA’s “action level” for lead in drinking water. Finally, zinc was detected in every sample collected, with five detections (one at a residence) higher than the screening value. The study did not report monitoring data for other metals.

B.2.2. Sampling Data for Select Drinking Water Suppliers in Northern Idaho

This section of the document summarizes sampling data for selected drinking water suppliers in northern Idaho. The goal of the section is to assess whether past mining activities in the CdA River Basin affected the quality of drinking water provided by suppliers. Accordingly, ATSDR and its contractors focused their review on water suppliers located along the CdA River, tributaries to this river, and Lake Coeur d’Alene. Overall, ATSDR obtained and examined records for 40 drinking water suppliers that draw groundwater or surface water from selected areas within the CdA River Basin. ATSDR compared measured contamination levels against published health-based screening values and examined contaminants of concern for the CdA River Basin (e.g., arsenic, cadmium, lead, and zinc) in greater detail. Water provided by a small subset of suppliers periodically had concentrations of various contaminants (e.g., arsenic, cadmium, mercury) that exceeded EPA’s Maximum Contaminant Levels (MCLs). However, a review of the locations and depths of the affected groundwater wells discloses that the sporadic elevated levels of these contaminants do not appear to be caused by mining wastes associated with the CdA River Basin site. Only one supplier

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[28] The reference document provides little information regarding exactly where the non-residential wells are located. It specifies that some of the non-residential wells are on industrial properties, and some are located near tailings piles (and are presumably monitoring wells). Further, the reference document does not comment on how (or if) groundwater from wells in the area is used.

was found to have contamination levels consistently exceeding MCLs, but that supplier closed last year.

The remainder of this subsection documents how ATSDR and its contractors gathered and summarized drinking water sampling data. The section first reviews how we identified water suppliers potentially affected by mining wastes and how we obtained these suppliers' sampling data; the discussion then describes the data available for the selected suppliers. Finally, the sampling data is summarized, using health-based screening values and drinking water standards to identify contaminants of potential concern. The memo concludes with options for follow-up activities. All tables and figures cited in the text appear in appendices A and B.

B.2.2.1. Approach Taken to Identify Water Suppliers and Obtain Sampling Data

ATSDR's first step in identifying drinking water suppliers in the CdA River Basin was to obtain a list of all water suppliers in the three Idaho counties—Benewah, Kootenai, and Shoshone—that lie within parts of the CdA River Basin. ATSDR's contractor's search focused on "community water systems" and selected "non-transient non-community water systems."[29] "Transient non-community water systems" were not considered, nor were water suppliers that have been inactive for many years. According to EPA's Safe Drinking Water Information System (SDWIS), the three counties searched include 137 water suppliers that met these search criteria.

The next task was to identify the water supplier subset most likely to be influenced by mining wastes in the CdA River Basin. This process began by contacting the owners of the individual water suppliers for additional information on their locations and sampling data. But these contacts generated very limited responses for various reasons (e.g., some suppliers did not answer the telephone, some suppliers indicated that they would not be able to provide data, some suppliers stated that they were not sure when they would be able to respond). After encountering these obstacles, ATSDR decided to contact the Idaho Department of Environmental Quality (IDEQ) to identify water suppliers and to obtain sampling data.

IDEQ provided ATSDR and its contractors extensive information on water suppliers in northern Idaho. First, IDEQ performed a query of its drinking water database to identify all water suppliers with intakes or groundwater wells located in areas potentially affected by mining wastes in the CdA River Basin. That query identified 52 community water suppliers and non-transient, non-community (NTNC) water suppliers in northern Idaho located within 5 miles of the CdA River (including the North Fork and South Fork) and Lake Coeur d'Alene.

[29] Only those "non-transient non-community water systems" that serve potentially sensitive populations, such as day care centers, schools, and hospitals were considered.

Contractors further reviewed information on these water suppliers to identify those most appropriate for this data summary. Per ATSDR's direction, the contractors excluded water suppliers located within the Bunker Hill Superfund site and NTNC water suppliers that do not serve potentially sensitive populations (e.g., day care centers, schools, hospitals). In this step, seven water suppliers located in Kellogg, Pinehurst, and Smelterville were excluded; and five NTNC water suppliers were excluded that served industrial facilities and businesses, including a U.S. Forestry Service nursery. After these steps were completed, 40 water suppliers remained for further analysis. **Table C10** provides descriptive information about these suppliers. Although it is unlikely that mining wastes from the CdA River Basin ever affected some of the selected water suppliers (e.g., the water suppliers located in St. Maries), ATSDR believes its selection criteria were appropriate for identifying the suppliers of greatest potential concern for this site. It is similarly unlikely that our search criteria failed to identify suppliers affected by the site's mining wastes.

B.2.2.2. Information Available on the Selected Suppliers

After identifying the water suppliers potentially affected by CdA River Basin contaminants, ATSDR obtained sampling data from IDEQ on the quality of the drinking water provided by the selected suppliers. IDEQ supplied two major information sources on drinking water quality:

1. *Database of sampling results.* IDEQ's Microsoft Access database of drinking water sampling data collected by selected water suppliers in Benewah, Kootenai, and Shoshone Counties. The database includes sampling results for chemical contaminants, but not for bacteriological or radiological contaminants. From IDEQ's database, ATSDR's contractor developed a master database of sampling data for the 40 water suppliers listed in **Table C10**. This master database includes 25,179 sampling data records. The sampling results were collected between 1979 and 2003; however, the overwhelming majority of the sampling results were collected either in the 1990s (75% of all records) or since 2000 (21% of all records).
   The master database included sampling results for 129 analytes, including 29 inorganic analytes and 100 organic analytes. The data were organized into these two categories because the primary CdA River Basin contaminants of concern are inorganic. The inorganic analytes, which include metals, elements, and inorganic compounds, account for 26% of the records in the drinking water database. On the other hand, the organic analytes, which include volatile organic compounds, semi-volatile organic compounds, numerous pesticides and herbicides—and residues from these pesticides and herbicides—account for 74% of the records in the database. In the next subsection of this document all of the sampling results IDEQ provided are summarized, even though organic compounds found in drinking water are not expected to result from mining wastes in the CdA River Basin.

   The number of sampling records logged in the database varied considerably from one supplier to the next. For instance, the database included several thousand records for the main water suppliers in the larger cities (CdA and Post Falls), but generally included between 100 and 500 records for the smaller water suppliers. The regulatory requirements determined the type and frequency of sampling that each supplier had to conduct, which then determined the number of sampling records available for a given supplier. Sampling frequencies also varied with analyte. Some suppliers sampled for certain analytes quarterly or annually, while most suppliers sampled once every 3 years for chemical contamination. Some suppliers have received violations for not collecting samples according to frequencies required by the Safe Drinking Water Act. The data summaries presented later in this subsection provide more specific information on sampling frequencies for the inorganic analytes in the database.

2. *Source Water Assessments (SWAs).* IDEQ also provided SWAs for almost every water supplier listed in **Table C10**. The SWAs contain background information on suppliers, including information about groundwater wells (e.g., location and depth), surface water intakes, hydrogeology, population served, potential contamination threats to drinking water, and a brief summary of water quality data. The following section refers to the SWAs only for those suppliers found to have elevated levels of contamination.

B.2.2.3. Summary of Drinking Water Quality Data

This section summarizes the 25,179 records of sampling data for the 40 water suppliers listed in **Table C10**. First, a brief summary of the organic analytes is presented, followed by a more detailed summary of the inorganic analytes, which include the contaminants of concern for the CdA River Basin. All sampling data considered in this discussion were taken from the water distribution system. As the next subsection of the document indicates, tap water samples were not provided.

The following paragraphs use health-based screening values to summarize the sampling data. The following hierarchy to select these values was used. First, ATSDR's "Drinking Water Comparison Values" were used to identify screening values. In cases where the table includes multiple screening values, the lowest value was selected for this summary. Second, in cases where no ATSDR screening values are available, other information sources, such as EPA Region III's Risk-Based Concentration Table, were consulted for other published health-based screening values. For contaminants without health-based screening values, secondary water quality standards included in EPA's National Secondary Drinking Water Regulations were used. It should be noted that these secondary standards are not health-based, but rather are set to protect drinking water from having undesirable aesthetic or cosmetic qualities

The remainder of this subsection summarizes the drinking water sampling data that IDEQ provided, first for organic analytes, and then for inorganic analytes:

Organic analytes. As noted previously, the drinking water database includes sampling results for 100 organic analytes. Only 17 of these were detected in at least one sample. For reference, **Table C11** lists the 83 organic analytes that were never detected by the water suppliers ATSDR considered; the table also lists the number of non-detect sampling results reported for each analyte. The IDEQ database does not specify detection limits for these analytes, but ATSDR assumes all sampling was conducted using laboratory analytical methods suitable for determining compliance with the Safe Drinking Water Act.

Table C12 summarizes the sampling data for the 17 organic analytes detected at least once. The table indicates the frequency of detection, the highest measured concentration, a health-based screening value, and the number of detections at levels greater than the corresponding screening values. As **Table C12** shows, 8 of the 17 analytes detected had at least one measured concentration greater than a screening value. Four of these eight analytes (1,2-dichloroethane, benzene, bromodichloromethane, and chlorodibromomethane) were at levels exceeding ATSDR's Cancer Risk Evaluation Guide screening value, but none had measured concentrations greater than EPA's corresponding Maximum Contaminant Level (MCL). One of the analytes (chloromethane) exceeded a Lifetime Health Advisory for Drinking Water in a single sample, but this contaminant does not have an MCL. The remaining three analytes had at least one measured concentration greater than their corresponding MCLs: one measurement of di-(2-ethylhexyl)-phthalate (9.3 ppb) taken in 1993 from the City of Harrison's water supply exceeded the corresponding MCL (6 ppb); one measurement of dichloromethane (7.92 ppb) taken in 2001 from the Dalton Water Association in CdA exceeded the corresponding MCL (5 ppb); and nine measurements of trichloroethylene (5.05–7.5 ppb) taken between 1995 and 1997 by wells in the City of CdA's water supply exceeded the corresponding MCL (5 ppb).

Overall, the sampling data indicate that the 40 water suppliers listed in **Table C10** do not contain unusually elevated amounts of 100 different organic chemicals. Only three chemicals were found at levels exceeding MCLs, and these elevated concentrations occurred only at isolated water suppliers. Also, the most recent testing at these suppliers has shown that their drinking water does not contain unsafe levels of chemical contamination. The organic analytes detected are not contaminants of concern for the CdA River Basin site and likely originate from other sources.

Inorganic analytes. The IDEQ database includes sampling results for 29 inorganic analytes, including several metals that are CdA River Basin contaminants of concern. The following paragraphs present data trends for the detected 21 analytes for which health-based screening values have been published. ATSDR did not conduct detailed reviews for the four analytes (aluminum, hydrogen sulfide, silver, and thallium) that were not detected in any samples or the four analytes (magnesium, potassium, silica, and sodium) that were detected in samples but have no published health-based screening values or secondary drinking water standards.

Table C13 summarizes overall trends among the drinking water sampling data for the 21 inorganic analytes ATSDR reviewed in detail. As the table shows, the measured levels of 15 of these analytes were safely below their corresponding screening values; ATSDR does not consider these analytes further. The remaining six analytes, on the other hand, had at least one measured concentration greater than screening values. A more detailed review of the data for these analytes follows:

- *Antimony.* Across the 40 suppliers listed in **Table C10**, 185 drinking water samples were analyzed for antimony. Antimony was detected in just one sample at a concentration (5.0 ppb) slightly higher than the lowest health-based screening value (4.0 ppb—an ATSDR Reference Dose Evaluation Guide for children's exposure). However, the lone detected concentration was lower than EPA's MCL (6.0 ppb). The single sample with elevated antimony levels was collected in November 1995 from the "Syringa Well," one of four groundwater wells that feed into the Ross Point Water District in Post Falls. This well was sampled again in 1998, but antimony was not detected.

  According to the SWA for this supplier (IDEQ 2001a), the Syringa Well is located approximately 1 mile north of the Spokane River, just east of Post Falls. The well is 275 feet deep, and water is collected from a screening range between 237 and 263 feet beneath the ground surface. Given this depth, it seems unlikely that the lone detection of antimony in this well resulted from sediments in the Spokane River contaminated with mining wastes from the CdA River Basin.

- *Arsenic.* According to **Table C13**, arsenic was detected in 29 of the 333 drinking water samples in the IDEQ database. All 29 detections exceeded ATSDR's Cancer Risk Evaluation Guide for arsenic (0.02 ppb), but only 8 detections exceeded EPA's MCL (10 ppb).[30] The levels found above EPA's MCL were observed in groundwater wells from three water suppliers: the City of CdA water supply, the Avondale Irrigation District, and the Rose Lake Water Association. A summary of each water supplier's arsenic detections follows.

  The IDEQ database includes 36 records of arsenic sampling data for the City of CdA water supply. These samples were collected in multiple wells over the years, but levels of arsenic exceeding EPA's MCL have only been observed in one—the Hanley Well. All five arsenic sampling results available for this well, dating from 1991 to 2002, have been greater than EPA's current MCL, and the detected concentrations range from 17 to 34 ppb. According to the SWA for this supplier (IDEQ 2002), the Hanley Well is located approximately 3 miles north of where the Spokane River flows from Lake Coeur d'Alene. This well is 400 feet deep, and water is screened at depths ranging from 290 to 340 feet beneath ground surface.

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[30] In 2001, EPA lowered its arsenic MCL from 50 ppb to 10 ppb. Water suppliers are not required to come into compliance with the revised MCL until 2006. This document uses the current MCL as an initial toxicity screen of the arsenic samples, even though many of the samples with elevated arsenic levels were collected years before the MCL was lowered. (Note: None of the arsenic sampling results in IDEQ's database exceeded EPA's former MCL.)

The SWA notes that the arsenic levels are likely of natural origin or result from runoff from orchards and certain types of industrial processes. Given the depth of the well and the distance from areas with metals-contaminated sediments, it seems unlikely that the elevated arsenic levels in the Hanley Well can be attributed to mining wastes from the CdA River Basin.

The second water supplier found to have elevated arsenic levels is the Avondale Irrigation District. Two water samples, one collected in 1988, the other in 1994, from this supplier's "Miles Well Field" had arsenic levels (16 ppb and 12 ppb respectively) greater than EPA's current MCL. This well field, however, is located nearly 4 miles north of where the Spokane River flows out of Lake Coeur d'Alene. Also, the individual wells in the field screen water at depths ranging from 345 to 412 feet beneath the ground surface (IDEQ 2001b). Thus it seems unlikely that the arsenic levels in this well field result from the mining wastes in the CdA River Basin.

The third water supplier with an elevated arsenic concentration is the Rose Lake Water Association, located in Cataldo. Rose Lake is one of the "lateral lakes" along the CdA River, downstream from where the North Fork CdA River and South Fork CdA River meet. This water supplier obtains drinking water from two groundwater wells: Well #1 and Well #4. Arsenic was detected at 16 ppb in a 1997 sample collected from Well #4, and this well apparently has not been tested again since. According to the supplier's SWA (IDEQ 2001c), Well #4 is 420 feet deep and is screened at depths ranging from 360 to 420 feet. Further, the SWA states that this well draws water from a depth overlain by 50 feet of a clay/shale aquitard. As a result, it is unlikely that surface contaminants (e.g., CdA mining wastes) caused the elevated arsenic levels in this water supply, even though the well is in close proximity to surface waters that are heavily impacted by CdA mining wastes.

- *Cadmium.* Cadmium was detected in 48 out of 382 drinking water samples collected from the suppliers listed in **Table C10**, and 33 of these detections were at levels greater than the lowest health-based screening value (an ATSDR Environmental Media Evaluation Guide for chronic children's exposure). However, only 15 of the detections exceeded EPA's MCL (5 ppb). ATSDR examined these detections further and noted that every concentration found at levels greater than EPA's MCL occurred at the Sunnyslope Subdivision water supplier in Mullan. This supplier is located along the South Fork CdA River, approximately 10 miles upstream from the Bunker Hill Superfund site.

  According to EPA's Safe Drinking Water Information System, this supplier used "purchased surface water" to serve a population of approximately 150 residents; however, the IDEQ database labels several samples as collected from "Well #1." Thus from the information currently available, whether the supplier provided surface water or groundwater is unclear. Regardless, the supplier closed in December 2002. No SWA is available for this supplier, most likely because it closed during the time IDEQ was preparing these reports. As a result, the reports and databases ATSDR obtained do not document what surface water body served this water supplier, nor do they document the extent to which groundwater was used. No other water supplier in the CdA River Basin has recorded cadmium levels greater than EPA's MCL.

- *Iron.* **Table C13** indicates that iron was detected in 52 out of the 80 sampling results in IDEQ's database, and 27 of the detections were at levels exceeding EPA's secondary drinking water standard (300 ppb). ATSDR emphasizes that this standard is not health-based. Rather, this "standard" is a guideline EPA developed to help suppliers monitor the aesthetic quality of their drinking water. The secondary standard for iron, for instance, is the concentration above which one might notice a rusty color in the water or a metallic taste, or the water might leave red or brown stains on surfaces. Because the standard is not health-based, this discussion does not review the elevated detections in detail, other than noting that levels greater than EPA's secondary standard have been found in 11 suppliers listed in **Table C10**. The actual number of suppliers with elevated iron levels might, in fact, be greater, because the Safe Drinking Water Act does not require suppliers to sample for analytes having secondary standards.
- *Lead.* The IDEQ database includes only 14 sampling records for lead. This limited number of sampling presumably results from the fact that lead is not listed among EPA's primary or secondary drinking water standards. Lead was detected in 3 of the 14 samples, and only one of the measured concentrations (31 ppb) exceeded EPA's Action Level for lead in drinking water (15 ppb). The one elevated detection occurred in 1999 in the Ross Point Water District in Post Falls. The source of the lead in this one sample is not known. Moreover, because only one sample was collected from this supplier, and because the majority of water suppliers listed in **Table C10** have no lead sampling data in IDEQ's database, the available sampling data provide only limited information on lead in CdA River Basin water suppliers.
- *Mercury.* Mercury was detected in 16 out of the 302 sampling results in IDEQ's database, but only 2 of the detections were at concentrations greater than EPA's MCL (2 ppb). The highest level observed (4.4 ppb) occurred in 1993 at Hanley Well in the City of CdA water supply. The SWA report indicates that this detection resulted from "mercury spilled into well casing when the mercury seal on a submersible pump motor failed" (IDEQ 2002). Mercury was detected at an elevated level following

this event, but has not been detected since the pump was repaired and the well water thoroughly flushed.

The other supplier that detected mercury at levels greater than the MCL was the City of Worley, which is located west of Lake Coeur d'Alene. Mercury was detected in a sample collected in 1980, but has not been detected in seven samples collected since that time. This supplier was considered in the study because it is less than 5 miles from the Lake Coeur d'Alene. But the wells serving this supply are located up-gradient from any surface water body containing mining wastes from the CdA River Basin. Therefore, it is unlikely that the mercury detected at this supply was caused by wastes associated with the CdA River Basin site.

In summary, 6 out of the 29 inorganic analytes in the IDEQ database had at least one concentration greater than screening values, with only three of these analytes exceeding health-based MCLs. Data from the SWAs strongly suggest that the elevated levels of these three analytes (arsenic, cadmium, and mercury) are not related to mining wastes associated with the CdA River Basin site.

B.2.3. Groundwater Samples Collected in the Vicinity of the Lateral Lakes

The lateral lakes are a series of more than 10 lakes located along the CdA River, between the towns of Cataldo and Harrison. ATSDR and its contractors identified only one report that characterizes groundwater quality along the shores of these lakes (Spruill 1993). This report documents the results of a 1990 field study of groundwater contamination in the vicinity of Killarney Lake—a lake residents and visitors use extensively for recreation. During the study, USGS collected a single, filtered groundwater sample from each of six monitoring wells with depths ranging from 3 to 33 feet. The wells were located at various locations between the eastern shore of Killarney Lake and the northern bed of the CdA River. All wells were within ½ mile of the CdA River and within roughly 1 mile of Killarney Lake. All six groundwater samples were analyzed in the field for general indicators of groundwater quality (e.g., pH), but only four of these samples were analyzed in a laboratory for concentrations of dissolved metals.

The study published two general types of conclusions: those regarding the hydrogeology and groundwater uses in the vicinity of Killarney Lake and those regarding groundwater quality in the area. Concerning the first type of conclusion, USGS reported that the hydrogeology of the area is not well understood, though groundwater in surficial sediments near Killarney Lake typically flows from the mountainous valley walls toward the CdA River. USGS indicated that sediments in the valley of the CdA River are hundreds of feet thick, as compared to the relatively shallow sediments in locations east of the Bunker Hill Superfund site (e.g., sediments near the town of Wallace are roughly tens of feet thick). Information on groundwater contamination in local bedrock is not available; no studies have been conducted to date on the relationship between groundwater in the surficial sediments and groundwater in the underlying bedrock. This data gap is important because USGS reports that ". . . most residents in the vicinity of

Killarney Lake have wells completed in fractured bedrock" (Spruill 1993). It is important to note that the sampling conducted in this study did not reach bedrock.

USGS concluded that the groundwater quality in the vicinity of Killarney Lake was highly variable, with notable concentration differences observed among the four wells from which samples were collected for metals analysis. Of the 20 metals considered in the laboratory analysis, only 7 had at least one dissolved groundwater concentration higher than screening values, which are primarily derived from assumptions of lifetime exposure. Specifically, of the four samples collected, maximum concentrations of the seven metals were as follows: antimony (11 ppb), arsenic (330 ppb), cadmium (62 ppb), lead (300 ppb), manganese (94,000 ppb), nickel (140 ppb), and zinc (69,000 ppb). Of these, only arsenic, cadmium, lead, manganese, and zinc had at least one concentration more than an order of magnitude higher than their corresponding screening values. Levels of the 13 other metals were lower than their screening values or involved chemicals without published screening values.

B.2.4. Groundwater Samples from Drainage Basins

East of the Bunker Hill Superfund site, Canyon Creek flows more than 10 miles from its headwaters near the Idaho-Montana border into the town of Wallace. There the creek empties into the South Fork CdA River. More than 20 mining sites and 10 milling sites are located in the Canyon Creek drainage basin, and reportedly, they generated more than 28 million tons of tailings (SAIC 1993). ATSDR and its contractors identified three studies that report levels of groundwater contamination in this part of the CdA River Basin. Two of the studies are based on antiquated sampling and analytical methods. ATSDR and its contractors relied strictly on the third source of information: data compiled on the URS database of environmental sampling records (URS 2000). These data include nearly 6,000 records of groundwater sampling results for metals and other inorganics collected by different consultants between 1993 and 1999. Groundwater samples were collected from more than 20 sampling locations that span most of the Canyon Creek drainage basin, from upstream locations at the town of Burke to downstream locations at the town of Wallace. The sampling locations included areas near mining and milling sites, as well as locations upgradient and downgradient of these sites.

Like Canyon Creek, Ninemile Creek flows into the South Fork CdA River in the town of Wallace. Five milling sites located in the Ninemile Creek drainage basin reportedly generated approximately 3 million tons of tailings (SAIC 1993). The URS database includes more than 1,000 records of groundwater sampling conducted at six locations throughout the Ninemile Creek drainage basin, from monitoring wells along upstream tributaries to wells in the vicinity of Wallace. Sampling locations included areas near mining sites as well as areas further removed from tailings piles. The database records for this subarea are all from a URS sampling effort, conducted from 1998 to 1999.

Table C14 summarizes the results of the various groundwater studies conducted in the Canyon Creek and Ninemile Creek drainage basins, as documented in the URS database. As the table shows, only six metals—antimony, arsenic, cadmium, lead, manganese, and zinc—had concentrations higher than the screening values for drinking water consumption in more than 10% of the samples. Of these, levels of cadmium, lead, and zinc exceeded screening values most frequently. Concentrations of silver, sodium, and thallium also exceeded screening values, but in only one or two samples, suggesting that the elevated levels of these metals may be outliers. The concentration of nitrite in two of the samples exceeded screening values.

Moon Creek is a tributary to the South Fork CdA River. Along the East Fork of Moon Creek are the Charles Dickens mine, the Silver Crescent mill site, and a large tailings pile—all of which are potential sources of metals contamination to local groundwater. Two research papers document sampling results for groundwater quality in the immediate vicinity of this mining area on the East Fork of Moon Creek (Paulson 1997 and Paulson & Girard 1996). The two papers, however, apparently present the same set of groundwater monitoring data.

Starting in October 1993, and lasting 2 years, researchers conducted quarterly groundwater monitoring at 12 wells in the immediate vicinity of the mine and mill site on the East Fork of Moon Creek. The groundwater sampled was not being used for drinking water. In fact, some wells in the study were located within 50 feet of the mill building and within 100 feet of a large tailings pile—locations where development of future drinking water supplies is highly unlikely. During the study, groundwater samples were analyzed for concentrations of 13 metals. Of these, only six (aluminum, cadmium, copper, lead, manganese, and zinc) have screening values. The maximum concentrations of all six metals were higher than their corresponding screening value. Specifically, the maximum detections were aluminum, 64,000 parts per billion (ppb); cadmium, 500 ppb; copper, 33,000 ppb; lead, 500 ppb; manganese, 8,000 ppb; and zinc, 154,000 ppb. Overall, groundwater concentrations of aluminum and copper exceeded their screening value in a relatively small fraction of samples. But concentrations of the other metals exceeded screening values for drinking water in half or more of the samples collected. Though this study documents elevated levels of metals in many groundwater samples, ATSDR and its contractors again stress that the sampling was limited to wells in very close proximity to mining waste sites—locations where use of groundwater wells for drinking water supplies is highly unlikely.

Pine Creek flows roughly 10 miles north from its headwaters to the town of Pinehurst, where it empties into the South Fork CdA River. Most of this drainage basin lies outside of the Bunker Hill Superfund site, though a small fraction is located within the site. Between 1994 and the present, several researchers have sampled groundwater at numerous locations within the Pine Creek drainage basin, as documented in more than 500 records in the URS database. **Table C15** presents summary statistics for these records. According to this summary, concentrations of eight metals (antimony, arsenic, cadmium, chromium, lead, manganese, nickel, and zinc) exceeded corresponding screening values in at least one sample from at least one monitoring well. Elevated concentrations were most prevalent for antimony, zinc, and cadmium, which exceeded screening values in 58%, 21%, and 17% of samples, respectively. Concentrations of all other metals exceeded screening values in fewer than 10% of the samples collected.

The only groundwater-quality study ATSDR and its contractors identified in non-CUAs west of the Bunker Hill Superfund site characterizes levels of contamination in the "Cataldo Mission Flats" (Galbraith 1971). The Cataldo Mission Flats are located along the CdA River, immediately downstream from the town of Cataldo and approximately 14 miles from where the CdA River empties into Lake Coeur d'Alene. Surface soils in the flats are composed largely of mine tailings that originated at upstream locations and have deposited over the years in this part of the Basin. Though the summary report does not specify the sampling dates, the samples were presumably collected between the late 1960s and 1971.

Interpretations of the sampling results for the Cataldo Mission Flats should consider the fact that groundwater sampling and analytical methods have improved considerably since the data for this study were published. ATSDR has specific concerns about the data quality, given that the report does not indicate whether concentrations are for dissolved or total metals, does not provide indicators of data quality (e.g., accuracy or precision estimates), and does not include summary data for some metals that are arguably of greatest concern for this site (e.g., cadmium). Nonetheless, for completeness, the maximum concentrations for those metals that were measured in this study and have screening values are copper, 30 ppb; lead, 1,300 ppb; manganese, 54,000 ppb; silver, 10 ppb; and zinc, 76,000 ppb. Of these data points, only concentrations of lead, manganese, and zinc exceed screening values. Even if these concentrations accurately represent groundwater contamination in Cataldo Mission Flats, it is unlikely that residents would draw drinking water from groundwater that flows through mine tailings.

B.2.5. Groundwater Samples from CUAs West of the Bunker Hill Superfund site

With one exception, the two compilations of environmental sampling studies in the CdA River Basin do not include any records of groundwater monitoring along the shores of Lake Coeur d'Alene (URS 2000 and CH2MHILL 1999). The URS database, however, does include results from two tap water samples collected at CUAs on the lake shores. One sample was collected from a groundwater well at Harrison Beach; the other sample was collected from a tap at Windy Bay. The CUA sampling report does not specify the depth of the well at Harrison Beach. Because the actual source of the tap water at Windy Bay is not known—though it is assumed to be groundwater (URS 1999)—results from this sample are not summarized here.

In the Harrison Beach tap water, only two metals—arsenic (6.4 ppb) and lead (15.5 ppb)—were detected at levels greater than corresponding screening values. These detections represent concentrations in "first-draw water samples," or water collected immediately after engaging the tap. These samples were not collected after purging the groundwater well, as was typically done in all other groundwater monitoring efforts in the CdA River Basin. Given that residents primarily use Harrison Beach for recreation, ATSDR notes that ingestion of groundwater from local wells likely occurs infrequently. According to the two compilations of environmental sampling data for the CdA River Basin (CH2MHILL 1999 and URS 2000), no studies have been conducted on the extent to which wastes from Silver Valley mining area contaminate groundwater resources along the Spokane River. In fact, one report from these sources suggests that "a great deal of interaction" exists between potentially contaminated surface waters in the Spokane River and groundwater in the underlying Spokane-Rathdrum Prairie Aquifer (WDOE 1997). Still, the report also identifies the "need to define the nature and extent of the interaction" as a future research need. Thus, no data are available from the compilations of sampling studies on the extent of metals contamination in groundwater supplies along the Spokane River.

B.3. Surface Water

B.3.1. Surface Water Samples from Areas Likely Frequented East of the Bunker Hill Superfund site and Common Use Areas

The URS database includes the results of nearly 2,000 samples collected in surface water bodies east of the Bunker Hill Superfund site. These samples were collected in creeks, gulches, rivers, and ponds. Overall, the relevant samples were collected from roughly 200 locations, making it difficult to prepare a site by site summary. As an initial screen for toxicity, ATSDR grouped the samples from eastern surface waters into 10 subareas. The sub areas were selected on the number of samples collected in the various creeks, ponds, rivers, and gulches in this part of the CdA River Basin. The various sampling efforts in this area focused exclusively on measuring concentrations of metals and other inorganics in surface water. **Tables 16a** through **16j** summarize the surface water monitoring data collected in the 10 subareas for contaminants of potential concern.

Following are delineations of the 10 subareas and more detailed reviews of the surface water sampling data collected in them:

B.3.1.1. Sub-area 1: Moon Creek Drainage

Moon Creek flows approximately 5 miles from its headwaters south to the South Fork CdA River. Moon Creek's confluence with the South Fork CdA River is approximately 2.5 miles downstream from the town of Osburn, Idaho, and roughly 2 miles upstream from the town of Elizabeth Park, Idaho. One mine operated in the Moon Creek drainage (on the east fork of the creek); this mine reportedly has an adit, a waste rock pile, and tailings in the creek bed (SAIC 1993).

The URS database documents the results of various agencies' sampling efforts conducted between 1991 and the present in the Moon Creek surface waters. Arsenic, cadmium, and lead were all measured at concentrations higher than screening values, and antimony and zinc were not. Moreover, none of the many other contaminants not listed in the table exceeded screening values. Cadmium and lead exceeded their screening values in fewer than 2% of the samples collected (**Table C16a**). Thus, the Moon Creek drainage does not appear to provide elevated loadings of the three contaminants detected throughout the CdA River Basin, i.e., cadmium, lead, and zinc.

B.3.1.2. Sub-area 2: Big Creek Drainage

As another tributary in the area, Big Creek flows approximately 7 miles north from its headwaters to its confluence with the South Fork CdA River at a location roughly 2 miles downstream from the town of Osburn, Idaho, and roughly ½ mile upstream from the mouth of Moon Creek. Two mining sites are in the Big Creek drainage, and two tailings ponds are located at the mouth of Big Creek (SAIC 1993). The URS database documents the results of various sampling efforts conducted in Big Creek surface waters between 1991 and the present (**Table C16b**). Surface waters in this drainage have not been sampled as extensively as those in the other subareas, but the limited data indicate that concentrations of antimony, arsenic, cadmium, and lead all exceeded screening values in at least one sample. No other contaminants measured in the Big Creek drainage had concentrations above screening values.

B.3.1.3. Sub-area 3: Ninemile Creek Drainage

Ninemile Creek flows roughly southward approximately 9 miles from its headwaters to its confluence with the South Fork CdA River in the town of Wallace, Idaho. The five mining sites that previously operated in the Ninemile Creek watershed generated an estimated 3 million tons of tailings (SAIC 1993). The URS database includes more than 6,000 sampling results for surface waters in this subarea (**Table C16c**). The results characterize contamination levels between 1991 and the present in the east fork, west fork, and main stem of Ninemile Creek and from several of the creek’s smaller tributaries (e.g., Black Cloud Creek and Wilson Creek).

Concentrations of arsenic, cadmium, lead, and zinc all exceeded screening values. It should be noted that levels of cadmium, lead, and zinc exceeded screening values in more than 75% of the samples collected in the Ninemile Creek drainage. This results partly from the fact that some of the sampling locations in this area are in close proximity to mining sites. But the high frequency of elevated concentrations suggests that Ninemile Creek provides a relatively high load of cadmium, lead, and zinc to the South Fork CdA River.

Manganese and thallium (**Table C16c**) were detected at levels greater than their corresponding screening value. More specifically, in 8 out of 142 samples collected, manganese was measured at levels greater than 500 ppb (the reference dose media guide [RMEG] for manganese). These eight measurements actually represent the results of four samples in which both the dissolved manganese and total manganese concentrations were greater than the screening value. The eight samples with the highest manganese concentrations were collected in mid-November 1998, and therefore could be more representative of a specific release or the impact of high flows rather than characteristic of long-term trends. On the other hand, in just 1 out of 134 samples the concentration of thallium exceeded the corresponding screening value (0.5 ppb, the lifetime health advisory [LTHA] guideline for thallium). This concentration was, however, “J” qualified, meaning that the measurement is an estimate of the actual concentration. Given this fact and the further fact that the estimated concentration is near the detection limit, whether the thallium concentration is greater than the screening value becomes an open question.

B.3.1.4. Sub-area 4: Canyon Creek Drainage

Canyon Creek flows more than 10 miles from its headwaters near the Idaho-Montana border to its confluence with the South Fork CdA River in the town of Wallace, Idaho. More than 20 mining sites and 10 milling sites are located in the Canyon Creek drainage; the sites reportedly generated more than 28 million tons of tailings (SAIC 1993). The database provided by URS documents the results of several surface water sampling efforts conducted between 1991 and the present in this subarea. Most of the data characterize water quality in Canyon Creek, but some data characterize water quality in Gorge Gulch a tributary that flows into Canyon Creek.

Concentrations of antimony, arsenic, cadmium, lead, and zinc in Canyon Creek waters all exceeded screening values in a subset of the samples. A unique feature of the monitoring data for this watershed (**Table C16d**) is the fact that antimony concentrations exceeded screening values in more than 70% of the samples, while far fewer or no such surplusages are observed in the other watersheds. Other contaminants frequently detected at levels greater than screening values are arsenic (36% of samples), cadmium (73%), and lead (60%).

Of the other contaminants, only copper, manganese and thallium had at least one concentration greater than a screening value for the Canyon Creek samples. Specifically, concentrations of manganese in two samples collected on May 24, 1999, exceeded screening values, but 195 other manganese measurements in this subarea were below the screening value. Copper was detected in above screening values in only one of 188 samples. Concentrations of thallium, on the other hand, marginally exceeded screening values in 3 out of 187 sampling results. All elevated concentrations were “J” qualified data, and are therefore estimated values and consequently viewed with caution.

B.3.1.5. Sub-area 5: Other Tributaries (Elizabeth Park to Wallace)

Numerous small tributaries flow into the South Fork CdA River east of the Bunker Hill Superfund site. While Moon Creek, Big Creek, Ninemile Creek, and Canyon Creek have been sampled extensively, the other tributaries in the area have not, even though many of them contain mining sites and wastes. ATSDR defines subarea 5 to include all tributaries (other than those specifically reviewed above) which flow into the South Fork CdA River between the towns of Elizabeth Park, Idaho and Wallace, Idaho. These tributaries include, but are not limited to; Montgomery Creek, Elk Creek, Terror Gulch, McFarren Gulch, Twomile Creek, Meyer Gulch, Shields Gulch, Argentine Gulch, Lake Creek, and Placer Creek. Various agencies have collected surface water samples from these tributaries periodically between 1991 and the present.

Concentrations of antimony, arsenic, cadmium, and lead in waters from some of these tributaries have exceeded screening values (**Table C16e**). Of the metals, arsenic had the most concentrations exceeding screening values (40% of the samples). The only other metal with concentrations above screening values was mercury. In one sample collected in Twomile Creek in November 1997, the concentration of dissolved mercury was 2.61 ppb—a level slightly higher than EPA's 2-ppb maximum contaminant level [MCL]. When this sample was analyzed for levels of total metals, the total mercury concentration was reported as nondetect (<0.2 ppb). Knowing that concentrations of total metals should exceed concentrations of dissolved metals for any given sample, the validity of this lone elevated mercury concentration is questionable. Sodium was also detected above screening values (≥20,000 µg/L drinking water equivalent level) in two of 93 samples.

B.3.1.6. Sub-area 6:Tributaries (upstream of Wallace)

Numerous additional small tributaries flow into the South Fork CdA River at locations upstream from the town of Wallace, Idaho. Because agencies have not routinely sampled these tributaries, ATSDR presents a summary for all of them combined. These tributaries include but are not limited to Grouse Gulch, Willow Creek, Slaughterhouse Gulch, Boulder Creek, the Little North Fork of the South Fork CdA River, Mill Creek, Weyer Gulch, Gold Creek, Gentle Annie Gulch, Deadman Gulch, Daisy Gulch, and Rock Creek. The only sampling studies documented in the URS database for these tributaries occurred from 1997 to the present.

According to **Table C16f**, concentrations of antimony, arsenic, cadmium, lead, and zinc in at least one sample from the tributaries exceeded screening values. Interestingly, concentrations of arsenic did so most frequently (in 34% of the samples). ATSDR notes that only 2 out of 102 samples from the tributaries had thallium concentrations greater than the screening value, and the concentrations in these two samples (0.59 ppb and 0.92 ppb) are only marginally higher than the screening value (0.5 ppb, LTHA).

B.3.1.7. Sub-area 7: South Fork CdA River (Elizabeth Park to Wallace)

The section of the South Fork CdA River between the Idaho towns of Elizabeth Park and Wallace is approximately 8 miles long. Metals detected in this stretch of the river originate from further upstream of the South Fork CdA River, from tributaries in subareas 1 through 5, and from contaminated sediments in this part of the river itself. This stretch of the river has been sampled extensively, and the URS database has a large volume of results, particularly for cadmium, lead, and zinc, collected from 1991 to the present.

The concentrations of antimony, arsenic, cadmium, lead, and zinc (**Table C16g**) have all exceeded screening values in many samples collected in this stretch of the South Fork CdA River. ATSDR notes that concentrations of cadmium were higher than the screening value in 96% of the samples—the highest frequency of elevated cadmium concentrations of the 10 subareas. Concentrations of arsenic (58% of samples) and lead (47% of samples) also frequently exceeded screening values. Not surprisingly, cadmium and lead concentrations in this part of the South Fork CdA River are consistently higher than in upstream locations on the river (i.e., subareas 8 and 9). Manganese exceeded its screening value in three samples collected in late May 1999, near Elizabeth Park. Though the three sampling results are all valid, with concentrations between 570 ppb and 790 ppb, ATSDR notes that concentrations of manganese were lower than screening values in 100 other samples collected in this stretch of the river.

B.3.1.8. Sub-area 8: South Fork CdA River (Wallace to Mullan)

Since 1991, several agencies have collected surface water samples in the 6-mile stretch of the South Fork CdA River between the Idaho towns of Wallace and Mullan. Every arsenic concentration measured (**Table C16h**) in this stretch of the river exceeded its screening value, and concentrations of cadmium and lead exceeded screening values in roughly 5% of the samples collected. No other metals or inorganics had concentrations greater than screening values in this stretch of the South Fork CdA River.

B.3.1.9. Sub-area 9: South Fork CdA River (upstream of Mullan)

Since 1991, several agencies have collected surface water samples at various locations over the 8 miles that the South Fork CdA River flows upstream of Mullan. The trends in these samples are similar to those for subarea 8: concentrations of arsenic frequently exceeded screening values (58% of samples); levels of cadmium and lead also exceeded screening values, but in fewer than 5% of samples (**Table C16i**), and concentrations of all other metals and inorganics did not exceed screening values.

B.3.1.10. Sub-area 10: Elk Creek Pond (Common Use Area)

In August 1998, EPA organized an environmental sampling project for "CUAs" in the CdA River Basin. Because the sampling procedures led to consistently higher metals concentrations than reviewed for the other subareas, the surface water sampling results collected during this project are presented as a separated subarea. Specifically, field personnel vigorously disturbed sediments before collecting five near-shore water samples in Elk Creek Pond, and those samples were analyzed only for total metals (not for dissolved metals). This sampling and analytical procedure was chosen such that measured levels would represent exposure point concentrations for individuals swimming or wading in the pond.

Table C16j reveals two key findings for the sampling conducted in Elk Creek Pond. First, concentrations of arsenic, cadmium, and lead) all exceeded screening values in all samples collected. Second, for these metals, the highest concentrations detected in Elk Creek Pond rank among the highest detected in all areas east of the Bunker Hill Superfund site. Thus the data suggest that disturbing contaminated sediments can lead to notable increases in surface water concentrations. In addition to the metals listed in **Table C16j**, levels of antimony (maximum 35 ppb), manganese (maximum 8,570 ppb), mercury (maximum 3.5 ppb), sodium (maximum 36,300 ppb), vanadium (maximum 40.7 ppb) and zinc (maximum 5,650) also exceeded screening values. ATSDR stresses that the elevated concentrations measured in Elk Creek Pond appear to result largely from the fact that sediments were intentionally disturbed prior to the sampling. Therefore, the sampling results are likely representative of exposure concentrations only for activities that disturb sediments (e.g., wading).

B.3.2. Surface Water Samples from Other Locations Likely Frequented East of the Bunker Hill Superfund site

B.3.2.1. Sub-area 1: Prichard Creek Drainage

Prichard Creek flows approximately 12 miles from its headwaters at the Idaho-Montana border northwest to the North Fork CdA River. The confluence of Prichard Creek and the North Fork CdA River is roughly 20 miles upstream from the confluence of the North Fork CdA River and the South Fork CdA River. Many mining sites operated in the Prichard Creek drainage, which includes Prichard Creek and several tributaries (SAIC 1993). According to the URS database, several different agencies collected surface water samples at various locations in the Prichard Creek drainage between 1997 and 1999. Samples were analyzed primarily for metals, both in dissolved and total form.

Of the four contaminants shown in **Table C17a,** only arsenic, cadmium, and lead had at least one measured surface water concentration in the entire Prichard Creek watershed higher than its corresponding screening value. In fact, for all three metals, measured concentrations exceeded screening values in fewer than 10% of the samples collected. In addition, one sample had a chromium concentration (71 ppb) higher than its screening value (30 ppb, RMEG), but this occurred for only 1 out of 96 samples collected in the Prichard Creek drainage. No other metals or inorganics had surface water concentrations higher than screening values.

B.3.2.2. Sub-area 2: Beaver Creek Drainage

Beaver Creek flows approximately 8 miles from its headwaters northwest to the North Fork CdA River. The confluence of Beaver Creek and the North Fork CdA River is located less than 2 miles downstream from that of Prichard Creek and the North Fork CdA River. More than 15 mining sites operated in the Beaver Creek drainage, either along Beaver Creek itself or along its tributaries (e.g., Carbon Creek and Trail Creek) (SAIC 1993). Between 1997 and 1999, several agencies sampled surface waters from Beaver Creek and its tributaries. These samples were analyzed for metals, both in dissolved and total form, and in other inorganics.

Table C17b shows a small fraction of samples (less than 15%) collected in the Beaver Creek drainage had concentrations of arsenic, lead, and zinc higher than screening values. On the other hand, one-third of the samples collected had levels of cadmium higher than screening values. In addition to the metals shown in the table, levels of chromium exceeded its value, but only in 1 out of 39 samples. No other metals or inorganics had concentrations greater than screening values in the Beaver Creek drainage surface waters.

B.3.2.3. Sub-area 3: North Fork CdA River

The North Fork CdA River flows more than 40 miles from its headwaters downstream to the town of Enaville, Idaho, where it and the South Fork CdA River merge. Between 1992 and 1999, various agencies have sampled surface waters from the North Fork CdA River and tributaries other than Beaver Creek and Prichard Creek. The locations sampled most frequently are the North Fork CdA River in Enaville, the North Fork CdA River upstream of the confluence with Prichard Creek, and the Little North Fork CdA River (a tributary to the North Fork CdA River). Other smaller tributaries were sampled, but to a lesser extent.

Concentrations of arsenic exceeded screening values in 3 out of 17 samples in this subarea (**Table C17c**) and concentrations of cadmium exceeded screening values in just 2 out of 67 samples. The three elevated arsenic concentrations occurred in three different locations: the North Fork CdA River at Enaville, Idaho; the North Fork CdA River between the confluences of Beaver Creek and Prichard Creek; and the Little North Fork CdA River. The two elevated cadmium concentrations occurred in two separate small tributaries to the North Fork CdA River. No other metals or inorganics had surface water concentrations in the North Fork CdA River drainage greater than corresponding screening values.

B.3.3. Surface Water Samples from Areas Likely Frequented West of the Bunker Hill Superfund Site and CUAs

The URS database includes more than 10,000 records of sampling results collected from locations west of the Bunker Hill Superfund site where periodic or even frequent human exposures to surface waters is probable. These sampling locations include rivers, creeks, and CUAs. The surface water sampling data for this area characterize levels of contamination in a large region having many different sources of contamination. To highlight spatial variations in surface water sampling data that are important to consider when evaluating exposures, this section summarizes the large volume of sampling results for distinct subareas. The summaries focus on the sampling data for metals, though data for other inorganics (e.g., chlorides, sulfates) are also considered.

When preparing the data summaries, ATSDR and its contractors generally did not consider the results of samples collected at locations within the Bunker Hill Superfund site. Thus, except as specifically noted, this section does not review sampling results from the South Fork CdA River between the Idaho towns of Pinehurst and Elizabeth Park. Nor does it review the results from tributaries sampled only at locations within the Bunker Hill Superfund site (e.g., Bunker Creek, Milo Creek, and Grouse Creek). Finally, this summary does consider sampling results from Pine Creek; sampling data are available at many sites along the several miles of Pine Creek upstream from the boundary of the Bunker Hill site.

The following summary focuses on contaminants (primarily metals) that have corresponding screening values. Trends for contaminants with drinking water standards based on the aesthetic quality of water but without screening values (e.g., iron and sulfates) are not highlighted in this section. **Tables 18a through 18c** summarize the surface water monitoring data collected in the area for the contaminants most often detected at levels greater than the corresponding screening value: antimony, arsenic, cadmium, lead, manganese, and zinc. Following are detailed delineations of the area and more extensive reviews of each subarea's surface water sampling data:

B.3.3.1. Sub-area 1: Pine Creek Drainage

Pine Creek flows approximately 10 miles north from its headwaters into the western edge of the Bunker Hill Superfund site, where it flows an additional 2 miles to the South Fork CdA River in the town of Pinehurst, Idaho. Several mining sites were located along the main stem of Pine Creek and in several of its tributaries (e.g., the east fork, Highland Creek, and Douglas Creek) (SAIC 1993). This summary considers all of the nearly 4,000 sampling results reported in the URS database for the Pine Creek drainage. These results represent samples collected between 1993 and 1999 at various locations throughout the drainage, including some locations within the Bunker Hill Superfund site.

Concentrations of antimony, arsenic, cadmium, lead, and zinc all exceeded screening values in at least one sample collected in the Pine Creek drainage (**Table C18a**). The elevated concentrations were most frequent for cadmium and zinc (37% and 17% of samples, respectively, with levels greater than screening values), and less frequent for antimony, arsenic, and lead (fewer than 10% of samples with levels greater than screening values). In addition to these five metals, manganese also had surface water concentrations in the Pine Creek drainage that were higher than screening values (500 ppb, RMEG), but only in 2 out of 161 samples. The two samples with the highest manganese levels were collected in upstream sections of the drainage. No other metals or inorganics had surface water concentrations in the Pine Creek drainage higher than corresponding screening values.

B.3.3.2. Sub-area 2: South Fork CdA River West from the Bunker Hill Superfund site

The South Fork CdA River flows for approximately 1 mile from the western boundary of the Bunker Hill Superfund site to its confluence with the North Fork CdA River in the town of Enaville, Idaho. To characterize surface water quality in this short stretch of river, ATSDR's contractors obtained sampling data collected between 1987 and 2000 at the western monitoring station of the Bunker Hill Superfund site (station SF-8) (TerraGraphics 2000b). This station is located between the mouth of Pine Creek and the end of the South Fork CdA River. The 27 sampling results for this location characterize concentrations of dissolved metals only; analysis of total metals was apparently not conducted.

The sampling data in this stretch of the South Fork CdA River (**Table C18b**) indicate that concentrations of dissolved arsenic, cadmium, lead, and zinc all exceeded their corresponding screening values. Cadmium levels exceeded screening values most frequently (i.e., in 85% of the samples collected) and lead levels least frequently (i.e., in 4% of samples). Sampling data in this stretch of river are also available for copper and mercury, but neither was detected at concentrations greater than their screening values.

B.3.3.3. Sub-area 3: CdA River, from the Confluence of the South Fork CdA River to Harrison

Near Enaville, Idaho, the North Fork CdA River and South Fork CdA River flow into the CdA River, which then flows roughly 25 miles west and empties into Lake Coeur d'Alene. The URS database includes more than 1,500 sampling records for the CdA River. Overall, IDEQ and USGS collected more than 90% of these data, between 1992 and 1999, at sampling stations near Rose Lake and in the towns of Harrison and Cataldo. As **Table C18c** shows, only arsenic, cadmium, and lead reached levels higher than screening values in the CdA River. Arsenic concentrations exceeded screening values in one out of the four samples analyzed for this metal; cadmium and lead concentrations exceeded screening values in 44% and 18% of the samples collected, respectively. No other metals or inorganics were measured at levels greater than drinking water screening values in this subarea.

B.3.3.4. Sub-area 4: Common Use Areas Along the CdA River

In 1998, EPA's contractors collected surface water samples at 23 CUAs along the entire CdA River. Because of key differences in how the samples were collected and analyzed, the sampling data for these areas are presented separately from those described in subarea 6. As noted previously, field personnel intentionally disturbed sediments before collecting the near-shore surface water samples at the CUAs. This sampling approach, combined with the fact that samples were analyzed for total metals (and not for dissolved metals), led to the measurement of notably higher concentrations than reported by the IDEQ and USGS sampling efforts. To illustrate this point, the data in **Table C19** clearly show that concentrations of arsenic, cadmium, lead and manganese all exceeded screening values in almost every sample collected in CUAs, while concentrations of antimony and zinc exceeded screening values in 70% and 85% of the samples collected, respectively. Further, the highest concentrations of the metals shown in **Table C19** all occurred in the CUAs (subarea 4).

As noted previously, interpretation of the CUA sampling results should account for the fact that samples were collected first by disturbing sediments. Thus, these results might be representative of exposures to people swimming or wading in the various locations along the CdA River. But they might not be representative of people drawing water from the river to drink, if such exposures occur. ATSDR notes that Tables 17 and 18 compare levels of contamination measured at the CUAs to the metals' corresponding screening values, which are typically derived for long-term exposure scenarios. When evaluating the public health implications of exposure to the concentrations listed in these tables, comparisons to acute exposure scenarios were utilized.

Over the years, the water and sediment in the lateral lakes have been contaminated by upstream loadings from the CdA River. The URS database has only limited sampling results for the lateral lakes, and all these results are for total metals (with none for dissolved metals). These sampling results can be classified into three general categories, which are reviewed below.

First, the URS database includes results for the 1998 sampling at two CUAs in the lateral lakes—at the Rainy Hill Picnic Area along Medicine Lake and at the shoreline of Thompson Lake. At both sites, field personnel collected five near-shore surface water samples, after having vigorously disturbed the local sediments. The samples were then analyzed for total concentrations of 23 metals. **Table C20** summarizes the sampling data for the five contaminants detected at levels greater than screening values in at least one sample. For both sampling locations, these contaminants were arsenic, cadmium, lead, and manganese. Antimony exceeded its screening value in all samples collected from the Rainy Hill Picnic Area. No other metals were detected at levels greater than screening values. As noted previously, the concentrations listed in the table reflect surface water contamination after sediments were disturbed.

Second, the URS database includes the results of a single water sample collected in 1998 from a tap at the Killarney Lake boat launch. The database does not, however, indicate the source of the tap water, which presumably is either from Killarney Lake itself or from a local groundwater source. Like samples from the other CUAs, this one sample was analyzed for concentrations of 23 metals. The following nine metals were detected: arsenic (4.3 ppb), calcium (17,300 ppb), iron (106 ppb), lead (3.4 ppb), magnesium (9,600 ppb), manganese (80.3 ppb), potassium (1,830 ppb), sodium (9,000 ppb), and zinc (2,550 ppb). Of these metals, only arsenic and zinc were detected at concentrations greater than their corresponding screening values.

Third, the URS database reports the results of four samples collected in 1991 by the University of Idaho: one sample was collected each at Anderson Lake, Black Lake, Medicine Lake, and Rose Lake. The number of metals for which concentrations are reported varies from sample to sample. Overall, however, total metals concentrations are available for at least some samples for arsenic, cadmium, copper, lead, and zinc. Only two of these metals had at least one concentration higher than its corresponding screening value. First, cadmium levels in Black Lake, Medicine Lake, and Rose Lake (cadmium concentrations were not reported for the sample collected in Anderson Lake) ranged from 6 to 20 ppb—all higher than the screening value of 2 ppb (EMEG). Second, the concentration of arsenic in Medicine Lake (20 ppb) exceeded its screening value (0.02 ppb, CREG); arsenic levels were not reported for the samples collected in the other three lakes.

The results of these three studies clearly are not sufficient to characterize surface water contamination in all of the lateral lakes along the CdA River. Nonetheless, the data confirm the presence of contamination in some lakes and suggest that contaminant levels can increase dramatically after local sediments are disturbed.

B.3.3.5. Sub-area 5: CUAs Along Lake Coeur d'Alene

Table C21 summarizes surface water sampling data collected in CUAs along Lake CdA. Elevated concentrations of arsenic and lead were detected in over 50% of samples analyzed. Cadmium, manganese, thallium, vanadium, and zinc were also detected at concentrations exceeding respective screening values. All samples considered in the table were collected after field personnel vigorously disturbed sediments.

B.3.3.6. Sub-area 6: Spokane River

From its source at the northern end of Lake Coeur d'Alene, the Spokane River flows more than 100 miles west across the Idaho-Washington state line, through the city of Spokane, Washington, and eventually into the Columbia River. Unlike the flow in the CDA River, the flow in the Spokane River is highly controlled, with several dams operating along its course. The controlled conditions likely lead to decreased sediment transport throughout this watershed, though transport of dissolved metals still occurs, as does some sediment transport. The URS database includes the results of two categories of sampling for the Spokane River: sampling from shorelines in the CUAs, and sampling from the main stem of the river itself. An account of general trends observed in both types of sampling follows:

In 1998, an EPA contractor sampled surface waters in six CUAs along the stretch of the Spokane River that flows in Idaho. Specifically, surface water samples were collected at North Idaho College Beach, Post Falls City Beach, Green Ferry Bay County Park, Black Bay, Corbin Park, and Blackwell Island. As explained previously, field personnel disturbed sediments before collecting surface water samples in the CUAs, resulting in the samples collected being representative of conditions where people swim or wade in the CUAs. All samples were analyzed for total metals.

Table C22 summarizes the CUA sampling data for the nine metals detected in at least one sample at levels greater than their corresponding health-based comparison values. As the table shows, elevated concentrations were detected most frequently for arsenic, cadmium, and lead. As emphasized throughout this document, the comparison values used in this summary are generally based on lifetime exposure scenarios. Accordingly, they are not representative of the recreational exposures that might occur with the measured concentrations.

Many surface water sampling studies have been conducted on the Spokane River, and the URS database presents the results of two such studies. In the first study, EPA contractors collected surface water samples on two occasions, in 1997 and 1998. These samples were collected at three locations on the Spokane River: immediately downstream from Lake Coeur d'Alene, at the Idaho-Washington state line, and in the city of Spokane. The samples were then analyzed for the levels of total and dissolved metals. In the second study, USGS collected surface water samples between 1997 and 1999 at seven locations along the Spokane River and in one of its tributaries. The USGS sampling locations were as far upstream as the city of Post Falls, Idaho, and as far downstream as near the mouth of the Spokane River in Long Lake. Overall, the URS database includes more than 1,000 records of surface water sampling results in the Spokane River—more than 100 samples were collected during these two efforts. Most samples were analyzed for concentrations of cadmium, lead, and zinc, and a smaller fraction were analyzed for concentrations of other metals. Of all the analytes considered, only arsenic was measured at concentrations (0.44–1.1 ppb) higher than its corresponding screening value. Arsenic was detected in half of the samples collected. No other metals or inorganics had concentrations higher than screening values.

Though not documented in the URS database, the Washington Department of Ecology has conducted several studies to characterize levels of PCB contamination in the Spokane River water, fish, and sediments. One study has reported limited surface water sampling results, suggesting that concentrations of total PCBs in the Spokane River range from not detectable to 220 ppb (WDOE 1995). According to this study, the origin of the PCBs in the Spokane River is believed to be various point sources in the state of Washington: the Silver Valley mining wastes are not believed to contribute to this PCB contamination.

B.3.4. Surface Water Samples from Mine Adits, Outfalls, Seeps, etc.

The results of more than 800 surface water samples collected at mine adits (an "adit" is an almost horizontal passageway into a mine), at outfalls, and at seeps from tailings ponds and other types of discharges east of the Bunker Hill Superfund site, are documented in the URS database. Most of these samples were analyzed for metals, both in dissolved and total form. Not surprisingly, the surface water sampled from the various types of mine discharges throughout the area contained many metals. **Table C23** shows that the following metals had at least one measured surface water concentration greater than the corresponding screening value: antimony, arsenic, barium, cadmium, cobalt, copper, lead, manganese, nickel, and zinc. The metals most frequently detected at levels greater than screening values were lead (75% of samples), arsenic (51%), cadmium (45%), and manganese (21%). ATSDR stresses that the screening values used in this analysis are based on the ingestion of surface waters, and some screening values are derived from assumptions of lifetime ingestion scenarios. That said, however, ingestion exposure to waters in discharges from mine sites in areas east of the Bunker Hill Superfund site is probably very rare, and frequent ingestion of these waters likely does not occur. Therefore, only acute exposures were considered.

The URS database documents the results of more than 100 surface water samples collected at locations west of the Bunker Hill Superfund site, from mine adits, outfalls, seeps from tailings ponds, and other types of discharges. These samples were analyzed primarily for metals, both in dissolved and total form. Many samples were also analyzed for sulfates, but these data are not summarized here because sulfates do not have a corresponding screening value. (ATSDR notes, however, that the measured sulfates concentrations in the mining wastes ranged from 3,000 to 549,200 ppb.) Samples from mining adits and mining waste were collected mostly from sites that operated in the North Fork CdA River drainage. In fact, more than 75% of the samples were collected in locations in the Beaver Creek and Prichard Creek drainages. Though this analysis presents a single summary for all samples collected in area mining locations, ATSDR stresses that the extent of contamination varied considerably from mining site to mining site.

For the metals and other inorganics analyzed at mining sites, **Table C24** lists the frequencies of detection, the maximum concentrations, and the number of samples with measured concentrations exceeding corresponding screening values. As the table shows, only the following nine metals had at least one concentration greater than the corresponding screening value at an adit, in an outfall, or in a waste pile seep: antimony, arsenic, cadmium, chromium, copper, lead, manganese, nickel, and zinc. Of these, levels of antimony, chromium, copper, and nickel exceeded screening values least frequently (in fewer than 5% of the samples collected). Concentrations of arsenic, cadmium, lead, manganese, and zinc, on the other hand, exceeded screening values more often (in 14% to 46% of the samples collected). Many of the screening values selected for this evaluation are derived from assumptions of lifetime ingestion of the contaminated water. Because persons could on occasion come into contact with surface water flowing directly from the mines and mining wastes, the screening values used in this analysis provide a very conservative screening analysis. As a more realistic exposure scenario, only acute exposures were considered.

B.4. Sediment

Table C25 summarizes sediment sampling data collected from locations east of the Bunker Hill Box. The table does not consider records from the URS database for sediment samples at depth (i.e., samples that do not include any of the top 6 inches of sediment) and records from which detailed information on the sampling locations were lacking. The sampling data in this table represent contamination levels in many different areas, including sediment from the South Fork CdA River, Big Creek, Canyon Creek, Ninemile Creek, and one CUA. Some sampling locations were in the immediate vicinity of mining sites and tailings piles, while others were at river sections far from such sources. In short, **Table C25** summarizes sediment samples over a large geographic area with highly varied levels of contamination. The concentrations of arsenic, copper, iron, lead, and zinc exceeded screening values in over 50% of the samples analyzed. The highest concentration of lead was detected in the bed of Canyon Creek, roughly 3 miles upstream from the South Fork of the CdA River. In cases were tables summarize data over extremely large geographic regions (e.g., all areas east of the Bunker Hill Box) that include both heavily contaminated areas and relatively uncontaminated areas, it is possible that the percentage of samples greater than screening values can be relatively low, even though areas with in the regions might have contamination at levels of health concern.

The URS database includes only limited sediment sampling data for five distinct locations west of the Bunker Hill Superfund site: the Pine Creek drainage (47 samples,

Table C26a), the CdA River (~800 samples, **Table C26b**), CUAs along the CdA River (~200 samples, **Tables C27a–C27b**), the CUAs along the lateral lakes (Rainy Hill picnic area along Medicine Lake and the shore of Thompson Lake (**Table C28a**), and samples collected by URS and the University of Idaho at other locations in the lakes (**Table C28b**). Tables 26a–28b present summary statistics for levels of sediment contamination at these locations.

According to data presented in Table C26a, the sediments in the Pine Creek drainage contain at least 10 metals with at least one concentration higher than its corresponding screening value. The concentrations of arsenic, lead and zinc sometimes exceeded the screening value by a factor of 10. Using data in Table C26b, the concentrations in sediment samples collected from the CdA River west of the Bunker Hill Box of aluminum, antimony, arsenic, copper, iron, lead, vanadium, and zinc were found to have often exceeded their respective screening values. The highest concentration of lead found in this segment of the river was collected between Springston and Medimont.

Tables 27a and 27b contain results of wet and dry samples collected from CUAs along the CdA River and selected tributaries. In these samples 12 metals were detected above screening values. The concentrations of the metals in the wet samples were higher than the concentrations in the dry samples. In a majority of the samples the concentration of arsenic, lead, and zinc exceeded the screening value by a factor of 10 or more.

The results of sediment sampling events occurring along the lateral lakes of the CdA River are shown in Tables C28a and C28b. Table C28a presents data from sampling collected at CUAs. The percentage of samples with concentrations exceeding screening values is low, especially when compared to sediment samples collected in other areas of the CdA River Basin. Arsenic was the only contaminant exceeding its respective screening value by a factor or 10 or higher. Vanadium was the only contaminant exceeding its screening value in all samples analyzed. Table C28b summarizes the results of sampling in non-CUAs. The concentrations of aluminum, arsenic, cadmium, lead, and zinc exceeded their respective screening values by a factor of 10 or more in some samples.

Though the URS database does not include sediment sampling results for any locations in the North Fork CdA River drainage, limited sampling results from a recent USGS publication suggest that the sediments in this area have notably lower levels of metals contamination (Farag et al. 1998). Specifically, the USGS study reported the following surface sediment levels for a sample collected in the North Fork CdA River at a location downstream from the Beaver Creek and Prichard Creek tributaries: arsenic (5.6 ppm), cadmium (0.3 ppm), copper (13 ppm), mercury (0.06 ppm), lead (57 ppm), and zinc (130 ppm). Of these, only arsenic was detected at levels higher than its corresponding screening value for soil (0.5 ppm, a CREG). For all these metals, however, the measured concentrations are considerably lower than the levels detected in the CdA River sediments. This suggests that the South Fork CdA River was, and still is, the predominant source of metals contamination of sediments in western locations.

Tables 29a and 29b contain the summary statistics for samples collected from CUAs along the shores of Lake Coeur d'Alene. Table C29a reviews concentrations measured in submerged (or "wet") samples, and Table C29b reviews concentrations measured in shoreline (or "dry") samples. In wet samples the concentration of vanadium exceeded its screening value in each of the samples analyzed. In dry samples the concentrations of arsenic, lead, and vanadium exceeded in some cases the respective screening value concentrations by a factor of 10 or more. The highest concentrations of lead were detected at Harrison Beach.

The URS database contains two subsets of sediment sampling data for the Spokane River: sampling of sediments in CUAs, and USGS sediment sampling at various locations along the river. Other researchers, most notably the Washington Department of Ecology, have also characterized metals contamination in the Spokane River; but that discussion focused exclusively on the results documented in the URS database. Though this approach provides a somewhat limited account of the available data, ATSDR believes the review of sampling results from the CUAs provides far greater insight into realistic exposure scenarios than do sampling results from deeper waters in the Spokane River.

Table C30 summarizes the sediment sampling results in the URS database and indicates three general trends: 1) many metals in the Spokane River have been found at levels exceeding conservative health-based comparison values, 2) the metals frequently detected at highest concentrations at upstream locations are also frequently found at elevated levels in the Spokane River, and 3) levels of aluminum and vanadium in the Spokane River sediments appear to be higher than they are in other parts of the CdA River Basin.

Though not documented in the URS database, the Washington Department of Ecology has recently conducted several studies to characterize levels of PCB contamination in the Spokane River water, in fish, and in sediments. One study has reported limited sediment sampling results, suggesting that concentrations of total PCBs in the Spokane River sediments range from non detectable to 4.5 ppm (WDOE 1995). According to this study, the origin of the PCBs in the Spokane River is believed to be various point sources in the state of Washington, and the Silver Valley mining wastes are not believed to contribute to any PCB contamination.

B.5. Aquatic Biota

B.5.1. Studies Conducted in the CdA River

ATSDR identified five studies reporting fish tissue sampling results for the CdA River Basin areas west of the Bunker Hill Superfund site and upstream of Lake Coeur d'Alene, excluding the lateral lakes (Farag et al. 1998; Hornig et al. 1988; Audet 1997; and Bauer 1974). In 1986 and 1987, EPA coordinated a screening survey of contamination levels in CdA River Basin fish. Because the survey was not statistically based, ATSDR cautions against forming conclusions from the data reported in the survey. In the samples taken—which were all fillets—cadmium levels ranged from 0.006 to 0.03 ppm, lead levels ranged from not detectable to 0.08 ppm, arsenic levels ranged from 0.09 to 0.22 ppm, mercury levels ranged from 0.034 to 0.063 ppm, copper levels ranged from 0.14 to 0.28 ppm, and zinc levels ranged from 4.3 to 6.4 ppm. While it is not known if the samples used in this survey truly represent fish tissue levels in this part of the river, the survey does provide evidence that various species of fish are contaminated with trace levels of metals typically associated with mining wastes.

In a study published in 1998, researchers from USGS collected fish samples at five locations along the CdA River, from the town of Cataldo westward to Harrison. Whole fish samples of yellow perch and a sample of the kidney or gill of different trout species were analyzed. ATSDR estimates that the wet-weight lead levels in the whole yellow perch ranged from an average of 3.8 ppm (samples collected near Rose Lake) to an average 14.4 ppm (samples collected in the CdA River near Harrison). Though these values are estimates and not direct measurements, ATSDR notes that the estimates are roughly an order of magnitude higher than the limited measurements of lead levels in yellow perch in this part of the CdA River Basin. Estimated average concentrations of cadmium and mercury in whole yellow perch samples were all less than 1.0 ppm on a wet-weight basis.

Other studies reviewed suggest that whole fish samples contain much higher concentrations of metals than fillet samples. Consistent with this point, sampling results from a limited number of cutthroat trout show that metals are not distributed evenly in fish tissues. On average, lead concentrations in the trout liver were 70 times higher than those in the fillet, zinc concentrations in the liver were 20 times higher than those in the fillet, and cadmium concentrations in the liver were more than 200 times higher than those in the fillet. These limited sampling results, when combined with those from other studies, start to paint a consistent picture: exposure doses calculated from fish fillet sampling results in all likelihood underestimate considerably the exposure doses for individuals who consume other parts of fish.

Overall, the studies reveal two key trends. First, the studies confirm that metals do not distribute evenly in fish tissues, and appear to concentrate in certain organs (e.g., gills, liver, and kidney) and possibly in other tissues. Second, the studies suggest notable differences in metals levels in fillets and in whole fish. EPA’s fillet data, though limited, suggest that lead and cadmium levels are less than 0.1 ppm for various species of fish; more recent whole fish sampling data for brown bullheads and juvenile yellow perch suggest, however, that average lead levels are higher than 10 ppm and average cadmium levels are roughly 0.5 ppm. Evaluation of contamination in other parts of the CdA River Basin revisits this observation.

B.5.2. Studies Conducted in the Lateral Lakes

ATSDR and its contractors identified eight studies reporting fish tissue sampling results for fish collected from the lateral lakes along the main stem of the CdA River (Hornig et al. 1988; Audet 1997; Audet et al. 1999; Bauer 1974; Bennett et al. 1990; Henny et al. 1991; ATSDR 1998; and Funk et al. 1975). Because of questions about the data quality and about whether the studies are representative, ATSDR presents only a limited review of the two earliest studies. ATSDR notes that the two earliest studies (Bauer 1974 and Funk et al. 1975) cite some of the same sampling results, thus they do not appear to be two entirely different sampling efforts. For several reasons ATSDR has concerns about the quality and representative nature of the sampling results from these studies. For instance, fish tissue samples from the studies were analyzed in two different laboratories that reportedly used slightly different analytical methods. Laboratory analytical techniques have improved considerably since the fish tissue samples were analyzed; the studies report results in dry-weight fish tissue concentrations, but do not provide enough information for reliably calculating wet-weight concentrations. And the studies do not report concentrations of lead—a metal of great concern for this site. Because these issues have not been resolved, ATSDR is not using the results of these studies in evaluating fish tissue concentrations.

Sampling results for the remaining six studies are reviewed below. Reviews are presented in chronological order, by the publication date of the studies:

B.5.2.1. Findings Presented in Hornig et al. 1988

During EPA's 1986–1987 field study of fish tissue contamination described earlier, the agency collected an unspecified number of fish from Killarney Lake (Hornig et al. 1988). Overall, one composite sample of fillets was analyzed for each of the following species: brown bullhead, yellow perch, black crappie, largemouth bass, and northern pike. Again, such limited sampling results likely do not characterize the nature and extent of fish tissue contamination. Still, the measured concentrations are presented here for completeness. In the five composite fillet samples, cadmium levels ranged from 0.007 to 0.031 ppm, lead levels from not detectable to 0.49 ppm, arsenic levels from 0.12 to 0.26 ppm, mercury levels from 0.086 to 0.37 ppm, copper levels from 0.14 to 0.39 ppm, and zinc levels from 3.9 to 7.8 ppm. All concentrations cited are on a wet-weight basis. Though the levels of contamination varied among the species, the significance of the observed variations is unclear given the limited sample size.

B.5.2.2. Findings Presented in Bennett, Falter, and Sawle 1990

This study surveyed levels of metals contamination in five fish species in Killarney Lake and recommended more extensive fish sampling efforts. During the 1989 study, the authors collected 50 fish: 10 each of largemouth bass, northern pike, black crappie, brown bullhead, and yellow perch. The fish fillets were analyzed for six metals at a University of Idaho laboratory. The fish tissue sampling effort found that average levels of cadmium, copper, lead, and mercury in the fish fillets were all less than 0.5 ppm, on a wet-weight basis. On the other hand, zinc had average concentrations in all species analyzed greater than 1.0 ppm, on a wet-weight basis. Interspecies differences were not pronounced, with the possible exception of elevated cadmium levels (0.12 ppm) in yellow perch fillets and elevated lead levels in brown bullhead (0.18 ppm) and yellow perch (0.13 ppm) fillets. The significance of these trends is questionable, however, given the limited sample size considered.

B.5.2.3. Findings Presented in Henny et al. 1991

In 1987, researchers from the U.S. Fish and Wildlife Service (USFWS) collected 21 fish samples from Thompson Lake to characterize lead exposures to osprey. The study reported whole fish concentrations for five species. Though the study's focus was on characterizing lead levels in the diet of piscivorous birds, the reported whole fish concentrations provide insights into potential lead exposures for humans who eat more fish parts than just the fillet. Results from this study include that the lead concentration in a composite of five whole brown bullheads was 21.6 ppm, on a wet-weight basis, the lead level in a composite of five whole yellow perch was 3.1 ppm, the lead level in a composite of five whole tench was 5.5 ppm, the lead level in a composite of four whole largemouth bass was 0.75 ppm, and the lead level in a composite of two northern squawfish was 0.86 ppm. The lead levels measured in Thompson Lake fish were all at least 20 times higher than those measured in the same species of fish from Lake Pend Oreille—a lake not impacted by Silver Valley mining wastes. As noted below, the lead levels in the whole fish samples are considerably higher than those reported in other studies for fillets.

B.5.2.4. Findings Presented in Audet. 1997

As noted previously, ATSDR's contractors obtained copies of fish tissue sampling data that was collected by USFWS and presented in a 1997 draft report, but never documented in a final report. Nevertheless, consultation with the author revealed that the sampling results are believed to be accurate and of high quality. The unpublished data are for a very limited number of whole fish samples, but even these limited data confirm that metals concentrations in whole fish appear to be considerably higher than those in fillets. Specifically, whole fish levels of metals were measured in a single cutthroat trout sample taken from Killarney Lake in 1992. Metals concentrations (all on a wet-weight basis) in this sample were lead, 2.5 ppm, zinc, 48.3 ppm, cadmium, 0.25 ppm, arsenic, 0.19 ppm, and mercury, 0.05 ppm. Further, two whole brown bullheads caught in Killarney Lake were analyzed for metals. The lead concentrations were reported in a separate publication (see below), and the average levels of other metals in these two samples were arsenic, 0.16 ppm, cadmium, 0.22 ppm, copper, 0.80 ppm, mercury, 0.077 ppm, and zinc, 24.8 ppm. The summary at the end of the list of bulleted items puts these levels of contamination into perspective.

B.5.2.5. Findings Presented in ATSDR. 1998

The most extensive fish tissue sampling effort conducted in the CdA River Basin to date was a 1995–1996 study conducted by Idaho Division of Fish and Game (IDFG) of contamination levels in fillets of three sport fish commonly caught in the lateral lakes of the CdA River Basin. The study was reviewed in ATSDR 1998. During this study, IDFG collected 312 fish and analyzed fillets for concentrations of cadmium, lead, and mercury. Three species were considered in this study: brown bullhead, northern pike, and yellow perch. Summary statistics for the fish tissue concentrations are contained in **Table C31**.

The table reveals several notable trends. First, average concentrations of all three metals in the fillets of the three species of fish were all less than 0.5 ppm. Second, in all species considered, cadmium levels in fillets were lower than both lead and mercury levels. In fact, for all three species average cadmium levels were between 5 and 25 times lower than the average lead levels. Third, the data reveal that the extent to which mercury is accumulated varies from species to species. Average mercury levels in northern pike were higher than the average lead levels; but average mercury levels in brown bullhead and yellow perch were lower than the corresponding average lead levels. This difference likely results from northern pike feeding at higher trophic levels than yellow perch and brown bullhead.

B.5.2.6. Findings Presented in Audet et al. 1999

As noted previously, this USFWS study was designed to characterize levels of lead in the diets of bald eagles. Still, the whole brown bullhead sampling results are relevant to this assessment; some human consumers of fish often use most, if not all, parts of fish in cooking. For these individuals, the whole fish sampling results could be a more appropriate surrogate for exposure- point concentrations than the fillet sampling results. During this study, 11 brown bullheads were collected from Killarney Lake, and an analytical laboratory measured the concentrations of lead in each whole fish. These analyses found an average lead concentration of 10.09 ppm, on a wet-weight basis, and lead concentrations ranging from 3.81 to 19.23 ppm.

Though interpreting the results of six fish tissue sampling studies performed for various reasons is difficult, ATSDR notes that some common trends emerge from all six studies. For instance, the three studies that examined metals concentrations in fish fillets (Hornig et al. 1988; Bennett et al. 1990; and ATSDR 1998) support the following: average cadmium concentrations in all species considered did not exceed 0.1 ppm, on a wet-weight basis. Average lead concentrations did not exceed 0.5 ppm, average mercury concentrations did not exceed 0.1 ppm, and average zinc concentrations did not exceed 10 ppm. On the other hand, the three studies that examined metals concentration in whole fish (Audit 1997; Audit et al. 1999; and Henny et al. 1991) all support the following: average lead concentrations in fish at lower trophic levels (brown bullhead, yellow perch, tench) ranged from 3 to more than 20 ppm. Thus the results of six independent studies appear to confirm that lead levels in whole fish in the lateral lakes, on average, are likely at least an order of magnitude greater than the lead levels in the corresponding fillets. This trend is perhaps best illustrated by examining data for brown bullhead, the species having the most abundant sampling data set for lead. In Killarney Lake, for example, the average lead level in 42 brown bullhead fillets was 0.13 ppm (ATSDR 1998), yet the average lead level in 11 whole brown bullheads was 10.09 ppm (Audet et al. 1999); in Thompson Lake, the average lead level in 41 brown bullhead fillets was 0.15 ppm (ATSDR 1998), yet the average lead level in a composite of five whole brown bullheads was 21.6 ppm (Henny et al. 1991).

Though no researcher has yet to conduct a statistically based study on levels of fish tissue contamination in all of the lateral lakes in the CdA River Basin, the available data provide insights into levels of contamination in several lakes with elevated metals concentrations in sediments. Further, the six studies that ATSDR believes are most reliable paint a consistent picture on the likely bounds of levels of metals contamination in fish fillets; these studies also strongly suggest that lead contamination in whole fish is considerably higher than that in fillets.

B.5.3. Studies Conducted in Lake Coeur d'Alene

ATSDR and the Idaho Division of Health (IDOH) jointly prepared a public health consultation to evaluate metals data reported for fish samples collected in 2002. Analysis of metals was completed in early 2003 and final results reported in May 2003. A fish consumption advisory for Lake CdA was issued jointly by the State of Idaho and the Coeur d'Alene Tribe in June 2003. ATSDR supported that advisory.

In 2002 Fish were collected from areas used by tribal and recreational fishers, and tested for 18 metals. Fillet and gutted whole carcass samples were used to estimate subsistence and sport/recreational exposures. Using information from tribal and sport/recreational anglers, ecological importance, relevance to other species, and patterns of exposure to chemicals, ATSDR sampled and analyzed bass (mostly largemouth bass, *Micropterus salmoides*), bullhead (mostly brown bullhead: *Ictalurus nebulosus*), and kokanee (*Oncorhynchus nerka)*.

Eliminated as contaminants of concern were antimony, barium, beryllium, chromium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc .Worst-case exposures used maximum metal levels and a traditional subsistence fish consumption rate (540 g/day). People are exposed to these metals, but adverse health effects are not likely. *No apparent public health hazard* exists for children or adults exposed to these metals in bass, kokanee, or bullheads.

Using subsistence and recreational consumption rates arsenic, cadmium, lead and mercury were evaluated further. N*o apparent public health hazard* for cadmium was determined. The other three metals presented varying concerns depending on the amount of fish eaten, the portion type (gutted carcass or fillet), and the species eaten.

Conservative evaluation of non-cancer effects of arsenic (i) used the highest average level (ii) assumed 20% inorganic arsenic, and (iii) used traditional subsistence consumption rates. While people are exposed to arsenic in fish, the resulting exposure dose estimates for adults and children are below levels that have been associated with health effects. For non-cancer effects of arsenic, *no apparent public health hazard exists* for adults or children exposed to arsenic levels found in bass, kokanee or bullheads.

Assessments for carcinogenic effects of arsenic used (i) resident and non-resident exposure durations, (ii) the highest average arsenic levels for gutted carcass and fillet samples, and (iii) assumed that inorganic arsenic was 20% of total arsenic. *No apparent public health hazard* is considered to exist for non-resident recreational consumers eating fillets of bullheads, bass or kokanee. Because of greater consumption rates and higher arsenic levels, a *public health hazard* may exist for traditional subsistence consumers exposed to arsenic in gutted carcass portions of bullheads, bass or kokanee.

Conservative evaluation of cadmium indicated the possibility of elevated exposures to cadmium. People typically consume a variety of fish species, use both fillet portions and gutted carcass portions, and eat lower amounts of fish than we used in our calculations. Each of these factors would result in exposures below our estimates. Therefore, *no apparent public health hazard* is considered to exist for children or adults exposed to cadmium in bullheads, bass or kokanee from Lake CdA.

Estimated blood lead increases were highest for traditional subsistence consumers of bullhead gutted carcass portions and lowest for non-resident, recreational consumers. A *public health hazard* may exist for adult traditional and contemporary subsistence consumers of bullhead gutted carcass portions, especially from the center of the lake. A *public health hazard* may also exist for adult, resident recreational consumers with existing blood lead levels >6–7µg/dL who eat gutted bullhead portions, especially from the center of the lake. *No apparent public health hazard* is considered to exist for adult, non-resident recreational consumers. *No apparent public health hazard* is likely to exist for adults who eat bullhead, bass, kokanee fillets, or gutted bass or kokanee portions.

Conservative evaluation of child lead exposures indicated that bullhead gutted carcass portions could push blood lead levels above the CDC benchmark (10µg/dL). A *public health hazard* may exist for children eating bullhead gutted carcass portions. A *public health hazard* may also exist for children (1–5 and 6–11 YOA) with elevated blood lead levels who eat 170 g/day or more of gutted bass or kokanee portions or bullhead fillets. Exposure to lead in soil or household dust is most likely to cause elevated lead levels.

Conservative evaluation of mercury used the maximum average concentration. Exposure dose estimates for traditional and contemporary subsistence fish consumers indicated the possibility of elevated exposures and adverse effects. Thus, a *public health hazard* may exist for pregnant women, women of childbearing age, young children, and adults who are subsistence fish consumers. *No apparent public health hazard* is thought to exist for non-resident recreational fish consumers exposed to the mercury levels found in these Lake CdA fish. *No apparent public health hazard* is likely for children eating 6.5 g of fish per day or less. *A public health hazard* could exist for children (2–6 and 7–14 YOA) who eat more than 65g day of fish per day.

Conservative approaches were used to evaluate adverse health impacts from exposure to 18 metals in two portion types of three fish species Lake CdA. Fifteen metals were determined not to be of concern. Three metals (arsenic, lead and mercury) were determined to present varying degrees of concern depending on the amount, portion type (gutted carcass or fillet), and fish species eaten.

Eating fish offers both benefits and risks. ATSDR recognizes that fish consumption rates are an important factor in assessing exposures and the potential for adverse effects. A wide range of consumption rates (6.5 to 540 g/day) and several exposure scenarios are included in this consultation. These were used to help gain a better idea of which fish consumption habits are more likely to result in adverse exposures.

B.6. Terrestrial Biota

This section reviews the results of the sampling studies that reported contamination levels in wildlife, garden plants, and wild plants in the CdA River Basin. When compiling data, ATSDR and its contractors considered all studies that were readily available and reported results that were believed to be of a known and high quality. ATSDR has concerns about the quality of data reported in sampling efforts conducted in the 1970s and earlier. Consequently, these sampling results are excluded from this document. This section summarizes the results of a large number of sampling projects, including those projects that appear to be largest in scope, but likely does not consider every sampling study conducted to date in the CdA River Basin. Therefore, this section should be viewed as an extensive, but not necessarily a comprehensive, account of the biota sampling studies for this site.

When evaluating the sampling studies, ATSDR split the available data into the following three categories: wildlife, garden plants, and wild plants. These categories were selected because basin residents have distinct consumption patterns for the three different types of biota listed, as explained in greater detail later in this document. For each category, the following paragraphs summarize the available sampling data. The summaries present data for the different areas within the CdA River Basin, but only in cases where detailed information on sampling locations was provided in the original references.

B.6.1. Wildlife Sampling Results

Over the past 40 years, researchers have measured levels of metals contamination in numerous different wildlife species in the CdA River Basin. These species include but are not limited to geese, swans, robins, ducks, swallows, mice, muskrats, voles, mink, and deer. Most studies that published levels of metals contamination in these wildlife species provided general, and not specific, descriptions of sampling locations. For instance, some studies reported that wildlife were collected “in the CdA River system” or “downstream from mining sites.” ATSDR does not, however, view having incomplete information on sampling locations as a data gap; most of the species sampled—especially the avian and mammalian species—have broad home ranges. Therefore, even if very specific sampling locations were provided, the measured concentrations would likely be representative of a far greater area—the species sampled might eventually be captured many miles away.

Table C32 summarizes the results of selected wildlife tissue sampling studies conducted in the CdA River Basin. As the table shows, the identified studies report concentrations for many different species and tissue types, but most focused on measuring metals contamination in the blood, kidney, and liver of wildlife.[31] Researchers typically determine contamination levels in these tissues to evaluate potential toxic effects to the wildlife as a result of exposure to metals. That said, however, most of the sampling results in table C32 have little significance to human exposure— people do not frequently consume the blood, kidneys, and livers of the sampled species. Nonetheless, the data in the table indicate that blood, kidneys, and livers of virtually every species studied to date contain trace levels of metals, primarily cadmium, lead, and zinc. Though not shown in the table, many of the studies cited concluded that the metals concentrations observed in biota from the CdA River Basin are significantly higher than those observed in biota from areas not affected by mining wastes (Audet et al. 1999; Henny et al. 1991; Blus et al. 1991; and Henny et al. 1994).

ATSDR identified only one large set of sampling data that systematically characterized metals contamination in muscle tissues of wildlife collected at locations outside the Bunker Hill Superfund site. These data were collected by the Idaho Department of Fish and Game (IDFG) in the 1980s and are documented in two summary reports (Krieger 1990 and Neufield 1987). In this sampling effort, IDFG collected 55 ducks—mallards, wood ducks, and coots—along the CdA River and from the lateral lakes. The livers, kidneys, bones (tibia), and breasts of these ducks were all analyzed separately for concentrations of cadmium, lead, and zinc. Though cadmium and lead were detected in a large fraction of liver, kidney, and bone samples, they were detected in less than 10% of the breast tissue samples (Krieger 1990). Specifically, cadmium was detected in just 5 out of the 55 breast tissue samples, and was never found at levels higher than 0.1 ppm; lead, on the other hand, was detected in only two of the samples, at 0.9 ppm and 1.6 ppm.[32] By contrast, the average concentration of cadmium and lead in the livers of the same samples were 0.9 ppm and 5.3 ppm, respectively. Therefore, this study indicates that cadmium and lead are rarely detected in duck breast, and other tissues in the same ducks—tissues that people do not frequently eat—contain much more significantly elevated levels of metals. This same trend was observed in a study of 30 ducks collected at locations along the Columbia River in Washington (Krieger 1990).

ATSDR and its contractors identified three additional data sets for metals contamination in muscle tissue of waterfowl. But detailed information was not provided on either the specific locations in the CdA River Basin where samples were collected, or the laboratory analytical methods used. First, a report notes that breast tissues were analyzed in 11 ducks (mallard and teal) and 2 Canada geese from along the CdA River between 1976 and 1985. Lead was reportedly detected in every sample, at levels ranging from 0.29 ppm to 1.75 ppm (Neufield 1987). The report does not specify, however, if these

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[31] Though not summarized in Table 28, some studies reported concentrations of metals in the guts and fecal matter from wildlife. This public health assessment does not summarize these sampling results, primarily because residents of the CdA River Basin probably rarely, if ever, consume these materials.

[32] The two reports summarizing IDFG's sampling do not indicate if the concentrations are on a wet-weight or dry-weight basis.

concentrations are on a dry- or wet-weight basis. Second, a report indicates that the average concentration of lead in the breast tissue of nine tundra swans was 0.49 ppm (with a maximum concentration of 0.76 ppm) and that lead was not detected in the breast of a single Canada goose sample (Audet 1997). Third, two reports present information on lead concentrations in duck breast tissue both before and after cooking, though the means of cooking are not specified (Krieger 1990 and Neufield 1987). The data in the two reports are not entirely consistent, but both sets of data suggest that the cooking practices employed had no important impact on lead levels in the breast tissues. Overall, these three studies, though limited in scope, provide additional evidence that metals, particularly cadmium and lead, are likely present at trace levels in the muscle tissue of waterfowl.

For wildlife other than waterfowl, virtually no data are available on the extent of metals contamination in muscle tissues for locations outside the Bunker Hill Superfund site. As the only exception, ATSDR identified one study that reported metals concentrations in a single deer muscle sample collected from an unspecified location in the CdA River Basin. This sample contained 0.21 ppm cadmium, 1.29 ppm lead, and 18.62 ppm zinc, but the report did not specify whether these concentrations are on a dry-weight or wet-weight basis (Audet 1997). Whether the results from this one sample represent levels of contamination in deer throughout the CdA River Basin is extremely uncertain.

In summary, several studies have concluded that a wide range of avian and mammalian species in the CdA River Basin have metals contamination in their kidneys, livers, bones, and blood—again, tissues and fluids that people likely do not consume frequently. Sampling data on muscle tissues from wildlife, on the other hand, are far more scarce. The most extensive and most recent study of contamination in breast tissue of ducks suggests that cadmium and lead are rarely found at detectable levels in these tissues. When detected, cadmium and lead were never found at levels higher than 0.1 ppm and 1.6 ppm, respectively. Other studies report comparable cadmium and lead concentrations consistent in muscle tissue of waterfowl. These limited data, however, might not be representative of contamination levels today or for species that were not sampled, and additional data would be needed to support a quantitative evaluation of human exposure to contaminants in terrestrial wildlife.

B.6.2. Garden Plant Sampling Results

Several researchers have collected and analyzed samples of fruits and vegetables grown in gardens in northern Idaho, but most considered locations within the Bunker Hill Superfund site. ATSDR identified two studies (**Tables 33-34**), however, that evaluated levels of contamination in home-grown produce for other areas in the CdA River Basin. First, EPA contractors recently collected, washed, and analyzed 34 vegetation samples from gardens in six basin communities, one west of the Bunker Hill Superfund site (Kingston) and the other five east of the site (URS 2000). Second, in 1976, the Idaho Department of Health and Welfare (IDHW) published levels of contamination in washed and unwashed beets, carrots, and lettuce in an unspecified number of samples collected from towns along the CdA River, in the Cataldo and Kingston areas (IDHW 1976).

Some consistent trends are apparent from the two sampling efforts, even though the available data are limited. Beets, carrots, cauliflower, and lettuce contain trace levels of metals contamination. Arsenic was detected in roughly half of the samples collected, and the detected concentrations were always at least five times lower than the corresponding levels of cadmium and lead measured in the samples. Cadmium and lead were detected in every sample collected, and cadmium levels ranged from 0.05 to 0.22 ppm, on a wet-weight basis, and lead levels ranged from 0.01 to 0.23 ppm on a wet-weight basis. Though the data suggest that contamination in some vegetables is higher than that in others, this trend cannot be confirmed by the 1998 EPA study due to the limited number of samples.

The IDHW sampling data were generally consistent with the data reported by EPA. Specifically, the IDHW results confirm that vegetables grown in locations throughout the CdA River Basin contain trace levels of cadmium and lead. Not surprisingly, the results indicated that concentrations of the metals, especially lead, in unwashed samples are generally higher than corresponding concentrations in washed samples. Finally, the concentrations reported in by the IDHW appear to be considerably higher than those reported by the EPA. Much of this difference, however, results from IDHW's data being reported as dry-weight concentrations. Knowing that the moisture content of beets, carrots, and lettuce typically ranges from 85% to 95% (URS 2000), ATSDR estimates that the wet-weight concentrations in IDHW's washed samples range from 0.2 to 0.6 ppm for cadmium and from 0.6 to 2.8 ppm for lead.[33] These ranges of wet-weight concentrations are generally consistent with the ranges of concentrations cited in the previous paragraph.

In summary, the available data on garden plant sampling clearly indicate that home-grown produce in the CdA River Basin accumulate metals from the soils, especially cadmium and lead. Levels of contamination in unwashed plants are higher than those in washed plants. Though the levels of contamination varied among plant species and sampling locations, the significance of these trends is unclear given the limited number of samples collected. It is, however, logical to assume that plants grown in areas with higher levels of soil contamination will probably be more contaminated than those grown in areas with lower levels of soil contamination. The most recent EPA sampling data indicate that cadmium concentrations in the various types of produce sampled range from 0.05 to 0.22 ppm and that lead levels range from 0.01 to 0.23 ppm. Arsenic, on the other hand, was detected in roughly half the samples, and never at levels greater than 0.01 ppm.

[33] This estimate is based on an assumed 90% moisture content for beets, carrots, and lettuce. This moisture content is consistent with the data reported by EPA (URS 2000). With this assumption, dry-weight concentrations are an order of magnitude higher than wet-weight concentrations.

B.6.3. Wild Plant Sampling Results

Many environmental sampling reports for the CdA River Basin site document levels of metals contamination in various species of wild plants. Though this sampling was generally conducted to characterize exposures to birds and mammals that consume wild plants, some sampling was designed to assess potential human exposures to contaminants in plants that are often consumed. The most detailed sampling data available are for water potatoes, which members of the Coeur d'Alene Tribe are known to consume. But only limited data are available for other types of wild plants that basin residents might gather and eat. The following summary reviews the available sampling data, grouped by the types of plants sampled:

B.6.3.1. Water Potatoes

An extensive investigation of water potato contamination in 14 wetlands of the CdA River Basin has recently been conducted (Campbell et al. 1999). In 1994, 95 water potatoes were collected from areas along the lateral lakes and the CdA River, and 50 were collected from a relatively uncontaminated site in the St. Joe River basin. Half of each sample was left unskinned and analyzed in the laboratory for concentrations of six metals, and the other half of each sample was skinned and analyzed. Water potatoes from the contaminated sediments of the CdA River Basin have significantly higher levels of metals contamination than those from the St. Joe River basin. In fact, the average lead concentration in water potatoes from the CdA River Basin (30 ppm, wet-weight) is much higher than the average lead levels reported in garden produce. Similarly, levels of contamination in skinned samples were considerably lower than those in unskinned samples: lead was detected in just 2 of the 95 skinned samples collected from the CdA River Basin, and in 90 of the 95 unskinned samples. Of particular note, cadmium and lead were not detected in any of the samples collected in the St. Joe River basin—the area where the Coeur d'Alene Tribe collects water potatoes today (Campbell et al. 1999; Phil Cernera, Coeur d'Alene Tribe, personal communication, February 22, 2000).

ATSDR's contractors identified two additional studies of contamination in water potatoes, but they are much more limited in scale. In one study six water potatoes were collected from each of nine unspecified locations in the CdA River Basin in the 1980s (Krieger 1990). The average concentrations of metals in the water potatoes varied from location to location, with average cadmium levels ranging from 0.5 to 3.2 ppm and average lead levels ranging from 14 to 411 ppm. This study does not indicate if these results are dry- or wet-weight concentrations, thus complicating efforts to compare the results to those documented above. In another study, a single water potato was collected and analyzed from an unspecified wetland in the CdA River Basin (Audet 1997). Concentrations for this sample, on a wet-weight basis, were lead, 13.78 ppm; zinc, 39.87 ppm; cadmium, 0.31 ppm; arsenic, 7.08 ppm; mercury, 0.03 ppm; iron, 1,765.1 ppm; and aluminum, 6.6 ppm.

B.6.3.2. Wild Rice

ATSDR identified only two occasions on which wild rice samples were analyzed, in 1985 and 1989. In 1985, wild rice was collected from two study areas near Thompson Lake. Lead concentrations in the roots of the wild rice samples ranged from 1.5 to 2.8 ppm on a dry-weight basis, while levels in the "upper parts" of the wild rice ranged from 638 to 992 ppm on a dry-weight basis (Krieger 1990). In the second study, 10 wild rice samples were collected in 1989, again from the Thompson Lake area. The samples were reported as having lead concentrations ranging from not detectable to 64.0 ppm, on a dry-weight basis, but it is unclear what parts of the rice plants were analyzed (Krieger 1990). ATSDR did not identify any accounts of residents harvesting wild rice from the Thompson Lake area.

B.6.3.3. Berries

ATSDR identified only one study reporting levels of metals contamination in wild berries (Audet 1997). An unspecified number of hawthorn berries were collected at three locations, two along the lateral lakes of the CdA River and one in the St. Maries River floodplain, which is not affected by Silver Valley mining wastes. The concentrations of lead in the two sampling locations in the CdA River Basin were reported as 2.25 ppm and 1.68 ppm, and that the sampling uncontaminated sampling location was reported as 2.21 ppm. The study did not indicate if the concentrations are on a dry- or wet-weight basis. Though these data are clearly limited, they do not suggest that wild berries in the CdA River Basin have notably higher levels of metals contamination than wild berries collected in uncontaminated areas. But this conclusion might only reflect the limited sampling conducted. ATSDR and its contractors did not identify any other studies that reported levels of contamination in berries in the CdA River Basin.

B.6.3.4. Other Wild Plants

Some studies ATSDR identified report levels of contamination in a small number of samples of various other wild plants, such as different species of grasses and weeds. These studies were primarily conducted to assess exposures to wildlife consuming these wild plants; they do not represent an exposure medium that people would frequently contact or ingest. Therefore, this assessment does not summarize the isolated sampling results for various grasses and weeds documented in the CdA River Basin reports.

It should be noted that although biota is discussed according to area where the plant or animal was grown or harvested for sampling, it is possible for people in other areas of the Basin to have consumed the plant or animal as part of their diet.

B.7. Air

The contaminated soils in the CdA River Basin study area can become airborne by various processes. For example, high winds can blow fine soil and dust particles into the air, as can cars driving on roadways covered in small amounts of dust and dirt. These airborne contaminants can enter homes through open doors, open windows, and air intake vents. Environmental conditions at the Bunker Hill Superfund site have been studied extensively for the last 50 years. ATSDR reviewed hundreds of Bunker Hill site records. The data ATSDR obtained span nearly 30 years, from 1970 to 1999 (**Tables 35-36**). Though the data collected are clearly extensive and provide a thorough and consistent account of air quality at the Bunker Hill site, ATSDR notes that the data do not provide a comprehensive picture of ambient air conditions outside of the site boundaries.

B.7.1. Total Suspended Particulates (TSP) and Particulate Matter (PM)

Monitoring stations were set up to collect air samples in the Kingston and Cataldo areas from 1974 to 1980, based upon the data reviewed by ATSDR. The samples were tested for total suspended particulates (TSP) and metals. The sampling frequency varied from location to location.

EPA formerly enforced a health-based National Ambient Air Quality Standard which required annual average concentrations of TSP (**Table C36**) to be less than 75 $\mu g/m^3$ and 24-hour average concentrations to be less than 260 $\mu g/m^3$. The highest annual average concentration of TSP in Kingston and Cataldo were 59.2 $\mu g/m^3$ and 92.9 $\mu g/m^3$, respectively (in 1979). The respective highest 24-hour averages were 7,179 $\mu g/m^3$ (in 1980) and 576.1 $\mu g/m^3$ (in 1974). **Table C37** shows how annual average TSP levels varied from one year to the next for ambient air monitoring stations in Shoshone County. **Table C37** shows how the highest 24-hour average TSP levels varied from one year to the next for ambient air monitoring stations in Shoshone County. The table presents data from 1975-1979 because this is the longest time frame when monitoring stations outside of the Bunker Hill site collected data while the smelting facilities operated. Data for 1980 were not included because of the influence that year from the Mount Saint Helens volcano.

For greater insight into the data trends, Table C37 presents annual average TSP levels for the monitoring stations operating between 1975 and 1979. These years were selected for analysis because all of the monitoring stations located outside the 21-square mile Bunker Hill Superfund site operated during much of this time frame. With the exception of the 1979 annual average measured at Cataldo, the TSP concentrations were lower for areas located outside of the Bunker Hill Superfund site. Every annual average concentration measured on the Bunker Hill site exceeded EPA's former health-based standard for TSP. By contrast, only very few annual average concentrations measured in Cataldo exceeded this standard. These trends seem to indicate that air quality, at least as far as TSP is concerned, was considerably worse on the Bunker Hill site as compared to other areas in this region of the CdA River Basin.

Ambient air monitoring data clearly show that TSP concentrations exceeded EPA's former health-based standard throughout the Bunker Hill Superfund site and beyond. Summarizing the data collected off site, annual average TSP concentrations reached potentially unhealthy levels in Cataldo in at least 1 year between 1975 and 1979. Twentyfour hour average concentrations reached potentially unhealthy levels in Cataldo and Kingston on infrequent occasions in the same time frame. The TSP levels measured at these locations are known to be associated with increased incidence of certain respiratory problems among exposed populations, especially among the elderly, smokers, children, and persons with pre-existing heart and respiratory problems.

Two monitoring stations in Shoshone County—one inside the Box and one to the east of the Box—have collected particulate matter (PM_{10}) data and submitted results to AIRS. The stations collected samples at frequencies ranging from every 2 days to every 6 days; all samples were 24-hour integrated samples and were collected using EPA-approved sampling devices. When evaluating trends in the PM_{10} monitoring data, ATSDR compared the measured concentrations to EPA's current NAAQS for PM_{10}, which requires that annual average concentrations be lower than 50 µg/m^3 and that 24-hour average concentrations be lower than 150 µg/m^3.[34]

For the years that the PM_{10} monitoring stations collected samples (1986–1999), **Table C39** lists annual average concentrations and the highest 24-hour average concentrations. As the summary table shows, annual average or highest 24-hour PM_{10} concentrations at Pinehurst School, which is located inside the Box, exceeded EPA's standards in 7 years between 1986 and 1998. Because of this, EPA has designated the city of Pinehurst, and some of its surrounding areas, as a non-attainment area for PM_{10}. This designation means that air quality has been detected at potentially unhealthy levels and that actions need to be taken to reduce emissions of particulate matter.

On the other hand, at the monitoring station outside the Box no 24-hour average or annual average PM_{10} concentrations have exceeded EPA's standards (see Table C39). In other words, the available data indicate that ambient levels of PM_{10} in Osburn have not exceeded EPA's standards at any time from 1991 to 1999. Combining the data trends for PM_{10} and TSP, ATSDR notes that the available data suggest that ambient air concentrations of particulate matter at locations outside of the Box have not exceeded standards since 1985. This finding should be viewed with caution, however, because only limited monitoring has taken place at locations outside the Box since 1985 (i.e., no monitoring was conducted between 1986 and 1990 at locations outside the Box, and only one station operated outside the Box between 1991 and the present).

B.7.2. Cadmium

Of the 24 stations listed in **Table C35**, 19 have ambient air concentrations of cadmium reported to AIRS. These concentrations were measured by analyzing TSP samples in the laboratory for cadmium content. Thus, the observations reported to AIRS are all 24-hour average values. The cadmium data in AIRS for Shoshone County runs from 1974 to

[34] Some scientists have argued that EPA's PM10 standards might not be protective of hypersensitive individuals. Thus, some subpopulations might suffer from pollution-related respiratory problems even when PM10 concentrations do not exceed EPA's standards.

1981; some stations measured cadmium levels throughout this time frame, and others measured cadmium levels for less than 1 year during this time.

To summarize the cadmium data, ATSDR evaluated trends among the highest concentrations and the average concentrations. As expected, the highest concentrations at a given station varied from year to year. At the 14 monitoring stations located within the Box, the highest cadmium concentrations ranged from 0.59 $\mu g/m^3$ (at Pinehurst School, in 1981) to 10.79 $\mu g/m^3$ (at Silver King School in 1978). At the five monitoring stations located outside the Box, on the other hand, the highest cadmium concentrations in any given year ranged from 0.07 $\mu g/m^3$ (at Mullan, in 1975) to 1.84 $\mu g/m^3$ (at the Osburn Radio Station, in 1978). Clearly, the peak concentrations at locations outside the Box were considerably lower than those within the Box—a trend that suggests that the primary air emissions sources of cadmium were located within the Box.

For insights into the long-term average levels of cadmium, **Table C39** presents annual average concentrations each station that had at least one full calendar year of data. No stations sampled for cadmium for the entire year in 1974 and 1981; therefore, annual average data are not presented for these years, even though some stations operated during parts of them. According to Table C39, annual average cadmium concentrations at the stations within the Box were higher than those at the stations outside the Box during every year between 1975 and 1980. Further, the cadmium concentrations in Smelterville were consistently higher than those in the other cities in Shoshone County. The most logical explanation for this trend is that the primary source of cadmium in the area was in close proximity to the monitoring stations in Smelterville. Looking strictly at the CdA River Basin data, the cadmium levels in Osburn were generally higher than those observed in other CdA River Basin locations.

B.7.3. Lead

Of the 24 monitoring stations considered in Shoshone County, 19 have data for lead reported to AIRS. Combined, these stations have reported nearly 10,000 ambient air concentrations of lead to AIRS to date. Consistent with data for cadmium, the lead concentrations all were measured by analyzing TSP filters, which were collected as 24-hour integrated samples. Most of the stations only collected lead samples during the 1970s; few collected lead samples during the 1980s, and only one station (the Medical Clinic station in Kellogg) continues to collect lead samples.

To evaluate the large volume of monitoring data for lead, the maximum concentrations at the various stations were compared to the lowest acute LOAEL reported in the ATSDR toxicological profile (28 $\mu g/m^3$); the annual average concentration was then compared to EPA's NAAQS (1.5 $\mu g/m^3$)[35].

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[35] Note, EPA's standard requires that ambient air concentrations of lead, when averaged over any calendar quarter, be lower than 1.5 $\mu g/m^3$. Comparison of annual average concentrations to this quarterly standard serves as a useful first step for evaluating the public health implications of inhalation exposures to lead, even though the concentrations and standards represent two different averaging periods. It should also be

The five monitoring stations located in OU3 never measured a single lead concentration greater than the lowest acute LOAEL, cited above. Of all of the monitoring stations located outside the Box, the monitor at the Osburn Radio Station consistently recorded the highest lead concentrations. At this station, the maximum lead concentrations in the years between 1974 and 1981 ranged from 3.66 to 21.65 μg/m^3. This trend most likely results from the fact that most smelting activities at the site ceased in 1981. At the other OU3 locations, which only sampled for lead between 1974 and 1980, maximum concentrations of lead ranged from 0.9 to 11.91 μg/m^3. In contrast, the highest levels of lead within the Box periodically exceeded the lowest acute LOAEL between 1970 and 1981. The station with the highest peak concentrations of lead was at Silver King School, which recorded levels greater than 28 μg/m^3 in every year it operated through 1981; in one year, 22 out of 143 lead concentrations at Silver King School exceeded the lowest acute LOAEL. After 1981, however, when most smelting activities ceased, the highest concentration of lead reported within the Box is 7.68 μg/m^3.

For insights into long-term trends in lead concentrations, **Table C41** shows annual average lead concentrations from 1975 to 1980 for the 11 stations with the most extensive data sets. Data from earlier years are not shown, because only three stations collected data in that time frame. Before 1975, the most notable data trend is that all three stations that were operating had their highest annual average concentrations during the years 1972 to 1974, roughly coinciding with the dramatic increase in lead emissions following the fire that destroyed pollution controls at the Bunker Hill site.

For the years between 1975 and 1980, the summary statistics in Table C41 reveal several notable trends. For instance, during this time frame, every monitoring station located within the Box measured annual average lead concentrations higher than EPA's quarterly standard—including one annual average (15.73 μg/m^3 at Silver King School in 1975) more than an order of magnitude higher than the standard. On the other hand, annual average concentrations measured in OU3 locations were generally lower than EPA's standard. As the exception, annual average lead concentrations in Osburn exceeded EPA's standard in 1975, 1976, 1977, and 1979. Once again, the summary statistics show that air quality within the Box was considerably worse than air quality in OU3.

As noted earlier, most smelting operations at the Bunker Hill Superfund site ceased in 1981, and lead concentrations decreased accordingly. Specifically, only at two monitoring stations, both located within the Box, did annual average concentrations exceed EPA's standard in 1981. From 1981 to the present, no monitoring station in all of Shoshone County has measured an annual average concentration greater than 1.5 μg/m^3. Thus, the data reported to AIRS clearly indicate that potentially unhealthy levels of lead in the air have not occurred anywhere at or near the Bunker Hill Superfund site between 1982 and the present.

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noted that EPA promulgated this standard in 1978, but the standard is used here to assess the health implications of levels measured prior to that time.

B.7.4. Sulfur Dioxide (SO_2)

The data downloaded from AIRS included measurements for sulfur dioxide concentrations at eight locations—five located inside the Box, and three located in OU3. The data appear to have been collected during two intensive studies. The first involved daily sampling of sulfur dioxide from April 1973 to May 1974 at four locations, all in the city of Kellogg. The second involved sampling at varying frequencies for all of 1976 and 1977 at one station within the Box (Pinehurst School) and three in OU3 (located in Cataldo, Osburn, and Wallace).

When reviewing the ambient air monitoring data for sulfur dioxide the measured concentrations were compared to EPA's standards. Specifically, EPA's NAAQS require that annual average concentrations of sulfur dioxide be lower than 80 $\mu g/m^3$ and that 24-hour average concentrations be lower than 365 $\mu g/m^3$. (Note, EPA also has a 3-hour standard for sulfur dioxide, but it is not a health-based standard.) Within the Box **Table C42a** shows, that levels of sulfur dioxide during the 1973–1974 study frequently reached potentially unhealthy levels. As the most extreme example, 24-hour average concentrations of sulfur dioxide exceeded EPA's 24-hour standard in nearly 40% of the samples collected in Smelter Heights, and the program-average concentrations at this station was more than four times higher than EPA's annual standard. During the 1976–1977 study, however, concentrations of sulfur dioxide were almost always lower than standards. Only once was sulfur dioxide measured at potentially unhealthy levels at an OU3 location (i.e., the Osburn Radio Station). Because emissions from smelting and other industrial facilities decreased considerably after 1977 and again after 1981, it is reasonable to assume that the sulfur dioxide concentrations at OU3 locations since 1977 were not greater than those listed in **Table C42b**.

B.8. Other Site Related Investigations

B.8.1. Food Consumption Data

For perspective on the extent to which people in the CdA River Basin might come into contact with contaminants in biota, ATSDR and its contractors obtained several accounts of food consumption patterns among basin residents. These accounts include surveys of local residents (ATSDR 1989), take limits for licensed hunters (URS 1999), a report on species of importance to the Coeur d'Alene Tribe (Striker 1993), and discussions with representatives of the Coeur d'Alene Tribe regarding the biota most frequently consumed (Phil Cernera, Coeur d'Alene Tribe, personal communication, February 22, 2000). The available data provide information about consumption of wildlife, water potatoes, and wild rice, but site-specific information on consumption of other locally grown food items is not readily available. The following observations are being considered when evaluating realistic exposure scenarios for basin residents:

B.8.1.1. Consumption Patterns for Wildlife

Wildlife consumption varies greatly among residents of the CdA River Basin, ranging from hunters who consume their takes to tribal populations who exhibit subsistence practices. The extent of consumption for hunters is largely limited by local licensing laws. Though ATSDR did not review these laws, a recent review of wildlife consumption in the CdA River Basin indicates that hunters' licenses in the region generally limit take of large game (e.g., deer), geese, and ducks to 2, 8 and 14 animals per year, respectively (URS 1999). Assuming hunters do not violate the terms of their licenses, these limits can serve as reasonable upper bounds for the amount of locally caught wildlife that hunters consume. That said, however, ATSDR did not identify any data that indicate actual wildlife consumption levels for hunters in the CdA River Basin. Tribal populations who engage in subsistence practices presumably are not required to abide by restrictions of hunting licenses, but ATSDR did not verify this. According to a representative of the Coeur d'Alene Tribe, its members do not typically consume small mammals; they do, however, consume waterfowl, including swans, and deer (Phil Cernera, Coeur d'Alene Tribe, personal communication, February 22, 2000).

The most detailed information on wildlife consumption is published in a 1989 ATSDR survey of food consumption practices among those who live near Lake Coeur d'Alene (ATSDR 1989). The surveyed population included 455 members of the Coeur d'Alene Tribe, 180 licensed fishers in Benewah and Kootenai Counties, and 293 additional persons who were identified as very high consumers of fish. The survey included questions on the extent to which respondents catch and consume duck and goose, but did not address consumption patterns for other forms of terrestrial wildlife. Overall, 92% of the tribal population, 87% of the licensed anglers, and 68% of the other respondents indicated that they never consume meals containing locally caught waterfowl. On the other hand, 3% of the tribal population, 0% of the licensed fishers, and 2% of the other respondents indicated that they consume one or two meals of duck or goose each week. ATSDR notes that the extent of duck and goose consumption probably varies from month to month—these animals might not be abundant in the CdA River Basin during some times of year. Also, hunting licenses might prohibit taking of duck and geese during other times of year. The ATSDR survey did not provide any additional information on consumption patterns for other wildlife species considered in this public health assessment.

B.8.1.2. Consumption Patterns for Water Potatoes

Several reports indicate that tribal populations in the CdA River Basin consume water potatoes growing in wetlands throughout northern Idaho (Campbell et al. 1999; ATSDR 1989; Striker 1993). ATSDR, however, identified two accounts indicating that the Coeur d'Alene Tribe members no longer consume water potatoes from the CdA River Basin because of perceived contamination. Instead, they consume water potatoes from the relatively uncontaminated St. Joe River basin (Campbell et al. 1999; Phil Cernera, Coeur d'Alene Tribe, personal communication, February 22, 2000). ATSDR's 1989 survey indicates the following consumption patterns for water potatoes: 1% of the tribal members who responded to the survey consume water potatoes once or twice a week; 7% of the tribal respondents reported eating less than one such meal per week; and the remaining 84% reported never eating water potatoes. All other study participants in the study—those with fishing licenses and those who ate large amounts of fish—reported not eating any meals containing water potatoes.

B.8.1.3. Consumption Patterns for Wild Rice

The only account of wild rice consumption ATSDR identified is ATSDR's 1989 survey, which reported that of the tribal respondents, 2% reported eating meals containing wild rice one to two times per week, 1.5% reported consumption at under one meal per week, and the remaining 96% did not consume any wild rice weekly. Of the respondents with fishing licenses, 10% reported having wild rice under once per week, and the remaining 90% indicated that they did not consume any wild rice. Of the respondents selected because they consume large quantities of fish, 2% ate wild rice once or twice a week, 23% did so less than once per week, and 75% did not eat wild rice at all. ATSDR notes that the survey asks if residents "serve locally harvested wild rice." Because the survey did not ask respondents to indicate exactly where the rice is harvested or otherwise define "locally harvested," it is unclear whether residents who consume wild rice tend to obtain it from areas contaminated with Silver Valley mining wastes.

B.8.1.4. Consumption Patterns for Other Biota

Information on consumption practices for other biota in the CdA River Basin is extremely limited. A report developed for the remedial investigation/feasibility study (RI/FS) indicates that residents gather wild berries (URS 1999), but the extent of consumption of wild berries is not known. Another author reports that other plants—ranging from wild onions to black tree moss to the cambium layer of pine trees—have been eaten by members of the Coeur d'Alene Tribe (Striker 1993). But the extent of consumption of these resources and levels of contamination in their tissues are not reported in any study that ATSDR identified.

B.9. Data Gaps

While reviewing available environmental sampling data, ATSDR noted several data gaps which could prevent a complete analysis of exposures possibly occurring within the CdA River Basin:

3. The source of the water for the tap at Killarney Lake boat launch is not known; it could be the lake itself or local groundwater.
4. Wells in the vicinity of the lateral lakes draw their water from the underlying bedrock, not from water in sediments. Sampling data of water from the fractured bedrock is needed to make an appropriate health determination.

5. Tap water samples from public and private drinking water supplies in the vicinity of Lake Coeur d'Alene are needed to determine if exposures at levels of health concern are occurring.
6. ATSDR currently has no data on the extent of metals contamination in groundwater supplies along the Spokane River.
7. While there are many studies showing levels of metals contamination in the liver, kidney, and bones of terrestrial biota, these parts of the animal are not often consumed by humans. Levels of contamination in muscle tissues (the parts normally eaten by humans) of animals normally consumed by local residents is needed to determine if those levels are of public health concern.
8. ATSDR currently has no data on the extent of metals contamination in ambient air for locations throughout the CdA River Basin site.

Appendix C–Tables

Table C1– Summary of Contaminants Detected in Residential Surface Soil (0”–6”) Samples, Above Screening Values or Western U.S. Background Values in the CdA River Basin, Locations East of the Box

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	2,155	2,155	1,240–35,700	LOC1 (10/9/98)	15,600	6,200	4,000	EMEG-ip	2,105 (97.7%)
Antimony	2,184	1,646	ND–617	LOC2 (3/30/00)	10	30	20	RMEG-c	219 (10.0%)
Arsenic	2,243	2,223	ND–1,700	LOC2 (3/30/00)	33	84	6	BKGD	2,146 (95.7%)
Cadmium	2,243	2,081	ND–115	LOC3 (5/10/99)	5.2	7.0	10	EMEG-cc	255 (11.4%)
Chromium	2,155	2,154	ND–255	LOC2 (3/27/00)	18	18	200	RMEG-c	2 (0.1%)
Cobalt	2,155	2,155	2.4–68.2	LOC4 (5/4/99)	9.6	5.4	20	EMEG-ip	84 (3.9%)
Copper	2,232	2,232	9–1,480	LOC2 (3/30/00)	79	100	60	EMEG-ip	754 (33.8%)
Iron	2,155	2,155	4,020–166,000	LOC2 (3/30/00)	22,200	11,100	23,000	RBC-n	586 (27.2%)
Lead	2,243	2,243	12.9–117,000	LOC3 (5/10/99)	1,400	4,100	400	SSL	1,272 (56.7%)
Manganese	2,155	2,155	67.7–11,800	LOC2 (3/30/00)	1,100	920	3,000	RMEG-c	80 (3.7%)
Mercury	2,229	2,008	ND–18.3	LOC2 (10/9/98)	0.7	1.3	4	EMEG-ip	59 (2.6%)
Thallium	2,155	327	ND–5.8	LOC5 (9/29/98)	0.6	0.5	5.5	RBC-n	1 (<0.1%)
Vanadium	2,155	2,147	ND–91.4	LOC4 (9/27/98)	21	7.7	6	EMEG-ip	2,105 (97.7%)
Zinc	2,243	2,242	ND–20,400	LOC3 (5/10/99)	780	1,000	600	EMEG-ip	873 (38.9%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels; an SV for mercuric chloride was used to evaluate mercury levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = residential location in Osburn; LOC2 = residential locations in Wallace; LOC3 = residential locations in Nichols Gulch; LOC4 = residential locations in Silverton; LOC5 = residential location in Burke.

Table C2– Summary of Contaminants Detected in Residential Surface Soil (0”–6”) Samples, Above Screening Values or Western U.S. Background Values in the CdA River Basin, Locations West of the Box

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	192	192	4,090–33,300	LOC1 (10/24/98)	12,400	5,000	4,000	EMEG-ip	192 (100.0%)
Antimony	184	110	ND–81.7	LOC2 (3/24/00)	4.7	9.0	20	RMEG-c	12 (6.5%)
Arsenic	206	205	ND–142	LOC3 (10/8/98)	25	32	6	BKGD	185 (89.8%)
Cadmium	206	168	ND–26	LOC2 (5/6/99)	3.0	4.1	10	EMEG-cc	16 (7.8%)
Copper	206	206	4.9–343	LOC2 (7/28/98)	47	54	60	EMEG-ip	39 (18.9%)
Iron	192	192	4,990–96,300	LOC2 (5/6/99)	21,800	15,700	23,000	RBC-n	32 (16.7%)
Lead	206	206	10.9–13,200	LOC2 (5/6/99)	840	1,900	400	SSL	61 (29.6%)
Manganese	192	192	142–9,790	LOC2 (5/6/99)	1,000	1,400	3,000	RMEG-c	14 (7.3%)
Mercury	206	139	ND–9.9	LOC3 (10/8/98)	0.8	1.9	4	EMEG-ip	16 (7.8%)
Vanadium	192	192	3.8–54.4	LOC2 (3/28/00)	21	8.0	6	EMEG-ip	190 (99.0%)
Zinc	206	206	34.7–8,150	LOC2 (5/6/99)	580	880	600	EMEG-ip	55 (26.7%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. An SV for mercuric chloride was used to evaluate mercury levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = residential location in CdA; LOC2 = residential locations in Kingston; LOC3 = residential location in Cataldo.

Table C3– Summary of Contaminants Detected in Surface Soil (0"–6") Samples from Schools and Daycares, East of the Box, and Above Screening Values or Western U.S. Background Values in the CdA Basin, Idaho

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	233	233	2,260–27,900	LOC1 (8/30/99)	16,000	4,800	4,000	EMEG-ip	232 (99.6%)
Antimony	215	170	ND–237	LOC2 (8/24/99)	6.1	17	20	RMEG-c	10 (4.7%)
Arsenic	233	233	1.5–742	LOC2 (8/24/99)	21	49	6	BKGD	211 (90.6%)
Cadmium	233	197	ND–45.2	LOC1 (8/30/99)	5.8	7.1	10	EMEG-cc	42 (18.0%)
Cobalt	233	233	3.8–55.6	LOC3 (3/22/00)	8.6	4.8	20	EMEG-ip	5 (2.1%)
Copper	233	233	8.5–617	LOC2 (8/24/99)	69	62	60	EMEG-ip	101 (43.3%)
Iron	233	233	9,030–114,000	LOC2 (8/24/99)	21,900	9,000	23,000	RBC-n	87 (37.3%)
Lead	233	233	25.5–11,900	LOC4 (8/28/99)	1,300	1,600	400	SSL	150 (64.4%)
Manganese	233	233	196–6,570	LOC4 (8/28/99)	1,200	910	3,000	RMEG-c	9 (3.9%)
Mercury	233	209	ND–12	LOC4 (8/28/99)	1.0	1.5	4	EMEG-ip	9 (3.9%)
Thallium	233	92	ND–9.4	LOC4 (8/28/99)	1.8	1.8	5.5	RBC-n	14 (6.0%)
Vanadium	233	233	2.4–39.8	LOC5 (8/28/99)	21	6.4	6	EMEG-ip	230 (98.7%)
Zinc	233	233	38.8–6,830	LOC4 (8/28/99)	1,030	1,200	600	EMEG-ip	111 (47.6%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. An SV for mercuric chloride was used to evaluate mercury levels.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Mullan High School (public area); LOC2 = unspecified location in Osburn; LOC3 = Mullan football field; LOC4 = Mullan Elementary play area; LOC5 = Mullan High School play area.

Table C4– Summary of Contaminants Detected in Surface Soil (0”–6”) Samples from Schools and Daycares, West of the Box, and Above Screening Values or Western U.S. Background Values in the CdA Basin, Idaho

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	95	95	3,500–21,000	LOC1 (9/14/99)	11,700	4,300	4,000	EMEG-ip	92 (96.8%)
Antimony	75	10	ND–205	LOC2 (8/26/99)	4.4	24	20	RMEG-c	2 (2.7%)
Arsenic	95	93	ND–130	LOC2 (8/26/99)	10	15	6	BKGD	67 (70.5%)
Cobalt	95	95	3.8–48	LOC1 (9/14/99)	15	10	20	EMEG-ip	22 (23.2%)
Copper	95	95	8.7–957	LOC2 (8/26/99)	39	105	60	EMEG-ip	4 (4.2%)
Iron	95	95	9,950–64,700	LOC1 (9/14/99)	26,600	13,600	23,000	RBC-n	45 (47.4%)
Lead	95	95	9.7–576	LOC1 (9/14/99)	110	100	400	SSL	3 (3.2%)
Manganese	95	95	140–4,570	LOC2 (8/26/99)	770	550	3,000	RMEG-c	1 (1.1%)
Thallium	95	37	ND–9.5	LOC2 (8/26/99)	1.5	1.4	5.5	RBC-n	2 (2.1%)
Vanadium	95	95	4–281	LOC1 (9/14/99)	55	59	6	EMEG-ip	91 (95.8%)
Zinc	95	95	28.6–815	LOC3 (9/13/99)	150	120	600	EMEG-ip	2 (2.1%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Rainy Hill, near Medicine Lake; LOC2 = Silver Meadow Adventist School in Cataldo; LOC3 = Killarney Road.

Table C5– Contaminants Detected in Common Use Area Surface Soils (0–6”) East of the Box Compared to Screening Values (SV)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	417	417	3,400–31,700	CUA90 (8/23/1998)	14,700	6,700	4,000	EMEG-ip	409 (98.1%)
Antimony	404	349	ND–233	CUA91 (8/28/1998)	8.9	22	20	RMEG-c	35 (8.7%)
Arsenic	419	419	2.8–1,060	CUA91 (8/28/1998)	27	78	6	BKGD	396 (94.5%)
Barium	415	415	26.6–4,300	CUA100 (8/26/1998)	230	220	4,000	RMEG-c	1 (0.2%)
Cadmium	419	412	ND–90.8	CUA95 (8/20/1998)	5.8	8.9	10	EMEG-cc	53 (12.7%)
Cobalt	417	417	2.7–61.4	CUA102 (9/11/1998)	9.2	5.3	20	EMEG-ip	11 (2.6%)
Copper	419	419	9.1–1,260	CUA91 (8/28/1998)	62	97	60	EMEG-ip	111 (26.4%)
Iron	418	418	6,370–143,000	CUA102 (9/11/1998)	21,900	12,300	23,000	RBC-n	102 (24.4%)
Lead	418	418	19.4–35,123	CUA96 (8/27/1998)	1,300	2,900	400	SSL	203 (48.6%)
Manganese	415	415	125–9,280	CUA80 (8/24/1998)	1,170	1,100	3,000	RMEG-c	15 (3.6%)
Mercury	422	370	ND–17.3	CUA95 (8/20/1998)	0.86	2.0	4	EMEG-ip	17 (4.0%)
Vanadium	420	420	1.8–36.2	CUA102 (9/12/1998)	19	6.4	6	EMEG-ip	414 (98.6%)
Zinc	418	418	45.7–18,000	CUA95 (8/20/1998)	960	1,900	600	EMEG-ip	150 (35.9%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for mercuric chloride was used to evaluate mercury levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Table summarizes samples from 0–1 inch below the surface and 1–6 inches below the surface.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA80 = Elk Creek Area; CUA90 = Wellman Field Park, Silverton; CUA91 = Wellman and Satner Field Parking Lot, Silverton; CUA95 = Satner Field, Silverton; CUA96 = Wallace City Park, Wallace; CUA100 = Wallace High School and Grammar School Playground, Wallace; CUA102 = Wallace Visitor’s Center and Parking Lot, Wallace.

Table C6– Contaminants Detected in Common Use Area Surface Soils (0–6”) West of the Box Compared to Screening Values (SV)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	404	404	1,840–37,400	CUA204 (9/2/99)	9,900	6,200	4,000	EMEG-ip	338 (83.7%)
Antimony	317	212	ND–58.6	CUA66 (8/2/98)	10	12	20	RMEG-c	70 (22.1%)
Arsenic	405	404	ND–492	CUA66 (8/2/98)	51	64	6	BKGD	338 (83.5%)
Cadmium	407	291	ND–86.4	CUA63 (8/27/98)	12	17	10	EMEG-cc	141 (34.6%)
Cobalt	402	402	2.5–106	CUA49 (8/31/98)	9	6	20	EMEG-ip	5 (1.2%)
Copper	404	404	5.1–310	CUA202 (9/1/99)	57	56	60	EMEG-ip	136 (33.7%)
Iron	404	404	7,580–222,000	CUA58 (8/27/98)	46,300	42,700	23,000	RBC-n	228 (56.4%)
Lead	404	404	5.8–7,250	CUA36 (8/14/98)	1,360	1,800	400	SSL	168 (41.6%)
Manganese	403	403	118–25,200	CUA59 (8/15/98)	3,480	4,660	3,000	RMEG-c	131 (32.5%)
Mercury	410	225	ND–11	CUA65 (9/10/98)	0.86	1.3	4	EMEG-ip	6 (1.5%)
Thallium	392	137	ND–11.3	CUA66 (8/2/98)	1.3	1.6	5.5	RBC-n	7 (1.8%)
Vanadium	404	391	ND–123	CUA25 (8/7/98)	22	16	6	EMEG-ip	344 (85.2%)
Zinc	404	404	26.5–13,600	CUA58 (8/27/98)	2,000	2,600	600	EMEG-ip	202 (50.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for mercuric chloride was used to evaluate mercury levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Table summarizes samples from 0–1 inch below the surface, 1–6 inches below the surface, and 0–12 inches below the surface.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA25 = Rockford Bay on Lake CdA; CUA36 = across CdA River from Springston; CUA49 = beach on CdA River near Killarney Lake; CUA58 = east of Blackrock Gulch Marsh; CUA59 = shore of CdA River east of Rose Creek; CUA63 = Bull Run Peak Beach along CdA River; CUA65 = shore of CdA River south of Mission Flats; CUA66 = beach on CdA River in Mission Flats; CUA202 and CUA204 = Spokane River, east of Spokane.

Table C7 – Contaminants Detected in Non-Residential Surface Soils (0–6”) East of the Box Compared to Screening Values (SV)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	52	52	636–37,200	LOC1 (10/25/98)	10,800	6,800	4,000	EMEG-ip	43 (82.7%)
Antimony	47	46	ND–3,150	LOC2 (5/19/98)	120	470	20	RMEG-c	16 (34.0%)
Arsenic	152	140	ND–3,610	LOC3 (11/10/98)	190	500	6	BKGD	131 (86.2%)
Cadmium	211	204	ND–225	LOC4 (5/19/98)	18	28	10	EMEG-cc	94 (44.6%)
Cobalt	52	51	ND–55.4	LOC1 (10/10/98)	13	9	20	EMEG-ip	10 (19.2%)
Copper	175	175	5.65–3,100	LOC5 (12/21/98)	210	360	60	EMEG-ip	113 (64.6%)
Iron	219	219	4,400–314,000	LOC6 (10/6/98)	47,200	50,000	23,000	RBC-n	129 (58.9%)
Lead	212	212	8.9–65,700	LOC7 (5/19/98)	7,200	11,600	400	SSL	142 (67.0%)
Manganese	152	152	12–27,700	LOC4 (5/19/98)	3,300	4,600	3,000	RMEG-c	46 (30.3%)
Mercury	51	51	0.05–37.2	LOC4 (5/19/98)	4	7	4	EMEG-ip	17 (33.3%)
Thallium	53	17	ND–8.6	LOC1 (10/25/98)	0.8	1.2	5.5	RBC-n	1 (1.9%)
Vanadium	52	51	ND–60.4	LOC3 (11/10/98)	18	12	6	EMEG-ip	45 (86.5%)
Zinc	214	214	0.691–40,900	LOC8 (10/12/98)	3,500	6,400	600	EMEG-ip	128 (59.8%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for mercuric chloride was used to evaluate mercury levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Table summarizes samples from 0–1 inch below the surface, 1–6 inches below the surface, and 0–12 inches below the surface.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations: LOC1 = Surface soils near Canyon Creek, between Gem and Burke; LOC2 = Tailings at Golconda mine; LOC3 = Surface soils near Canyon Creek, near Burke; LOC4 = Surface soils at Golconda mine; LOC5 = Surface soils near the Mullan landfill; LOC6 = Rex Mine site along Canyon Creek; LOC7 = Railroad near Golconda mine; LOC8 = Unspecified location along Canyon Creek, near Gem.

Table C8 – Contaminants Detected in Non-Residential Surface Soils (0–6”) West of the Box Compared to Screening Values (SV)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	16	16	433–16,700	LOC1 (7/19/94)	7,700	5,200	4,000	EMEG-ip	11 (68.8%)
Antimony	16	12	ND–437	LOC2 (7/25/94)	39	110	20	RMEG-c	3 (18.8%)
Arsenic	66	66	4.6–2,500	LOC3 (1/1/97)	150	330	6	BKGD	62 (93.9%)
Cadmium	155	148	ND–82.6	LOC2 (7/25/94)	15	14	10	EMEG-cc	87 (56.1%)
Copper	98	98	3.17–2,020	LOC4 (10/6/98)	120	260	60	EMEG-ip	55 (56.1%)
Iron	152	152	578–192,000	LOC5 (10/9/98)	63,500	42,200	23,000	RBC-n	117 (77.0%)
Lead	151	151	5.08–11,600	LOC4 (10/6/98)	2,900	2,300	400	SSL	121 (80.1%)
Manganese	66	66	37.3–10,500	LOC6 (1/1/00)	1,800	2,700	3,000	RMEG-c	11 (16.7%)
Vanadium	16	16	1.1–26	LOC7 (7/18/94)	12	8	6	EMEG-ip	10 (62.5%)
Zinc	155	155	0.07–12,500	LOC8 (10/5/98)	1,800	2,300	600	EMEG-ip	103 (66.5%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Table summarizes samples from 0–1 inch below the surface, 1–6 inches below the surface, and 0–12 inches below the surface.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = former mill site in the Pine Creek drainage; LOC2 = tailings in Pine Creek drainage; LOC3 = tailings near mine site east of CdA Lake; LOC4 = soils near Bull Run Lake; LOC5 = soils in Mission Flats area; LOC6 = flood plain soils near CdA Lake; LOC7 = soils near a tailings pile in the Pine Creek drainage; LOC8 = unspecified location near Cataldo.

Table C9– Groundwater Sampling Data for Osburn Flats

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Cadmium	11	7	ND–50	LOC1 (12/20/94)	18	17	2	EMEG-cc	7 (63.6%)
Lead	11	2	ND–42	LOC2 (11/15/94)	20	10	15	EAL	2 (18.2%)
Zinc	11	11	ND–4,330	LOC3 (9/7/97)	1,820	1,700	2,000	LTHA	5 (45.5%)

Notes: Source of data: MFG 1996.
Table summarizes results of 11 groundwater samples collected during the study. Sampling was conducted in both residential wells and non-residential (monitoring) wells.
ND = non-detect. The detection limits reported for cadmium and lead were 4 µg/L and 30 µg/L, respectively. The detection limit for lead is higher than the screening value. Therefore, sampling results that were non-detects for lead might actually have been higher than the screening values.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = non-residential well near past stockpile of milling waste; LOC2 = Silver Hills Middle School; LOC3 = non-residential well alongside Interstate 90 freeway interchange.

Table C10 – Summary of Water Suppliers Considered in this Public Health Assessment					
Supplier ID	**Supplier Name**	**City**	**County**	**Population Served**	**Notes (see Footnote)**
1050005	Cherry Creek Trailer Park	St. Maries	Benewah	18	GW, C, A
1050008	Cottonwood Point Water Assn.	St. Maries	Benewah	73	GW, C, A
1050020	Parkline Mobile Home Park	St. Maries	Benewah	40	GW, C, A
1050021	City of Plummer	Plummer	Benewah	800	GW, C, A
1280008	Avondale Irrigation District	Hayden	Kootenai	4,150	GW, C, A
1280041	Cave Bay Community System	Worley	Kootenai	200	GW, C, A
1280046	Chateaux Water Assn., Inc.	Hayden	Kootenai	275	GW, C, A
1280053	City of CdA	CdA	Kootenai	28,790	GW, C, A
1280059	Dalton Water Assn., Inc.	CdA	Kootenai	2,000	GW, C, A
1280077	Green Ferry Water Assn.	Post Falls	Kootenai	700	GW, C, A
1280222	Harbor View Estates	CdA	Kootenai	26	SW, C, A
1280081	Harding Acres Tracts	Post Falls	Kootenai	33	GW, C, A
1280083	City of Harrison	Harrison	Kootenai	250	GW, C, A
1280257	Hayden Pines Grouse Meadows	Hayden	Kootenai	700	GW, C, A
1280092	Hidden Hill Mobile Home Park	CdA	Kootenai	40	GW, C, A
1280096	Hoffman Troy Water Corp.	Hayden	Kootenai	358	GW, C, A
1280100	City of Huetter	CdA	Kootenai	90	GW, C, A
1280104	Kidd Island Bay Water Users	CdA	Kootenai	125	GW/SW, C, A
1280106	Kootenai County Water Dist. 1	CdA	Kootenai	454	SW, C, A
1280107	Kootenai High School Dist. 274	Harrison	Kootenai	350	GW, NTNC, A
1280117	Leisure Park	Hayden	Kootenai	132	GW, C, A
1280124	Mountain View Park	CdA	Kootenai	75	GW, C, A
1280138	Pinegrove Duplexes	Bayview	Kootenai	50	GW, C, A
1280142	Pinevilla Park and Water Assn.	Post Falls	Kootenai	500	GW, C, A
1280147	City of Post Falls	Post Falls	Kootenai	10,814	GW, C, A
1280161	Rose Lake Water Assn.	Cataldo	Kootenai	240	GW, C, A
1280163	Ross Point Water District	Post Falls	Kootenai	3,000	GW, C, A
1280164	Royal Highland Water System	CdA	Kootenai	275	GW, C, A
1280166	Savory Mobile Home Park	Post Falls	Kootenai	100	GW, C, A
1280271	Syringa Water and Sewer	CdA	Kootenai	40	GW/SW, C, A
1280206	City of Worley	Worley	Kootenai	300	GW, C, A
1400012	Cataldo Water District	Kingston	Shoshone	600	GW, C, A
1400016	E. Shoshone Co. Water (Burke)	Wallace	Shoshone	100	SW, C, A
1400017	E. Shoshone Co. Water (Mullan)	Wallace	Shoshone	821	SW, C, A
1400019	E. Shoshone Co. Water (Wallace)	Wallace	Shoshone	2,040	SW, C, A
1400030	Kingston Water District 1	Kingston	Shoshone	800	GW, C, A
1400035	M and H Trailer Park	Osburn	Shoshone	45	GW, C, A
1400039	Murray Water Works	Kingston	Shoshone	34	GW/SW, C, A
1400038	Serenity Terrace	CdA	Shoshone	26	GW, C, NA
1400049	Sunnyslope Subd.	Mullan	Shoshone	150	SW, C, NA

Notes: The "Notes" field indicates the drinking water source (GW = groundwater; SW = surface water; GW/SW = both groundwater and surface water), the type of water supply (C = community water supply; NTNC = non-transient non-community water supply), and whether the water supply is currently operating (A = active, NA = not active, as of 2002).

Table C11 -Organic Analytes Not Detected in Any Samples from Water Suppliers

Analyte	Number of Samples	Analyte	Number of Samples
1,1,1,2-Tetrachloroethane	251	Dieldrin	109
1,1,1-Trichloroethane	311	Dinoseb	104
1,1,2,2-Tetrachloroethane	251	Diquat	79
1,1,2-Trichloroethane	311	Endothall	79
1,1-Dichloroethane	251	Ethylbenzene	311
1,1-Dichloroethylene	311	Ethylene Dibromide	81
1,1-Dichloropropene	251	Foaming Agents	1
1,2,3-Trichlorobenzene	169	Glyphosate	79
1,2,3-Trichloropropane	251	Heptachlor	104
1,2,4-Trichlorobenzene	311	Heptachlor Epoxide	104
1,2,4-Trimethylbenzene	123	Hexachlorobenzene	118
1,2-Dichloropropane	311	Hexachlorobutadiene	169
1,3,5-Trimethylbenzene	169	Hexachlorocyclopentadiene	117
1,3-Dichloropropane	251	Isopropylbenzene	169
1,3-Dichloropropene	249	m-Dichlorobenzene	251
2,2-Dichloropropane	251	Methomyl	80
2,4,5-TP (Silvex)	113	Methoxychlor	113
2,4-D	116	Metolachlor	108
3-Hydroxycarbofuran	80	Metribuzin (Sencor)	112
Alachlor (Lasso)	117	Monochlorobenzene	311
Aldicarb	80	Naphthalene	169
Aldicarb Sulfone	80	n-Butylbenzene	169
Aldicarb Sulfoxide	80	n-Propylbenzene	169
Aldrin	109	o-Chlorotoluene	251
Atrazine	128	o-Dichlorobenzene	311
Benzo(a)pyrene	117	Oxamyl (Vydate)	81
BHC-gamma (Lindane)	113	p-Chlorotoluene	251
Bromobenzene	251	Pentachlorophenol	105
Bromochloromethane	169	Picloram	103
Bromomethane	251	p-Isopropyltoluene	169
Butachlor (Machete)	112	Polychlorinated Biphenyls	83
Carbaryl	80	Propachlor	112
Carbofuran	81	sec-Butylbenzene	169
Carbon Tetrachloride	311	Simazine	117
Chlordane	104	Styrene	311
Chloroethane	251	tert-Butylbenzene	169
cis-1,2-Dichloroethylene	311	Toxaphene	113
Dalapon	103	trans-1,2-Dichloroethylene	311
di-(2-Ethylhexyl)-adipate	129	Trichlorofluoromethane	169
Dibromochloropropane	81	Vinyl Chloride	300
Dibromomethane	251	Xylenes	311
Dicamba	88		

Notes: Chemical names are exactly as they appear in the IDEQ database. Detection limits were not provided for these chemicals.

Table C12 - Summary of Drinking Water Sampling Data for Organic Analytes Detected in at Least One Sample

Analyte	Number of Samples	Number of Detections	Highest Measured Concentration (ppb)	Health-Based Screening Value (ppb)	Type of Screening Value	Number of Detections Greater than Screening Value
1,2-Dichloroethane	311	1	0.6	0.4	CREG	1
Benzene	311	2	0.96	0.6	CREG	2
Bromodichloromethane	307	26	3.6	0.6	CREG	17
Bromoform	307	8	1.2	4	CREG	0
Chlorodibromomethane	307	12	2.0	0.4	CREG	11
Chloroform	307	45	57.8	80	MCL	0
Chloromethane	251	2	5.39	3	LTHA	1
Dacthal (DCPA)	1	1	1.51	70	LTHA	0
di-(2-Ethylhexyl)-phthalate	128	3	9.3	3	CREG	2
Dichlorodifluoromethane	170	1	1.25	1,000	LTHA	0
Dichloromethane	311	6	7.92	5	MCL	1
Endrin	113	1	0.00011	2	MCL	0
p-Dichlorobenzene	311	1	1.0	75	MCL	0
Tetrachloroethylene	311	13	3.8	5	MCL	0
Toluene	311	1	3.0	200	EMEG	0
Total Trihalomethanes (TTHM)	306	53	59.6	80	MCL	0
Trichloroethylene	311	79	7.5	5	MCL	9

Notes: Chemical names are exactly as they appear in the IDEQ database. Detection limits were not provided for these chemicals.
Abbreviations for health-based screening values follow:
CREG = ATSDR Cancer Risk Evaluation Guide
EMEG = ATSDR Environmental Media Evaluation Guide (the value in this table is for children's exposure of intermediate duration)
LTHA = EPA Lifetime Health Advisory for Drinking Water
MCL = EPA Maximum Contaminant Level for Drinking Water
Although some concentrations of 1,2-dichloroethane, benzene, bromodichloromethane, and chlorodibromomethane exceeded ATSDR's CREG value, no sampling results for these chemicals exceeded their corresponding MCLs

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Table C13 - Summary of Sampling Data for Inorganic Analytes Detected in at Least One Sample

Analyte	Number of Samples	Number of Detections	Highest Measured Concentration (ppb)	Health-Based Screening Value (ppb)	Type of Screening Value	Number of Detections Greater than Screening Value
Antimony	185	1	5.0	4	RMEG	1
Arsenic	333	29	34	0.02	CREG	29
Barium	297	52	170	700	RMEG	0
Beryllium	183	1	3.0	4	MCL	0
Cadmium	382	48	13	2	EMEG-c	33
Chloride	295	285	37,000	250,000	NSDWR	0
Chromium	305	5	20	30	RMEG	0
Copper	7	2	70	300	EMEG-i	0
Cyanide	63	1	40	200	MCL	0
Fluoride	549	82	1,100	2,000	NSDWR	0
Iron	80	52	7,800	300	NSDWR	27
Lead	14	3	31	15	EAL	1
Manganese	53	31	470	500	RMEG	0
Mercury	302	16	4.4	2	MCL	2
Nickel	185	3	10	100	LTHA	0
Nitrate (measured as Nitrogen)	952	691	6,160	10,000	MCL	0
Nitrite (measured as Nitrogen)	200	1	314	1,000	MCL	0
Nitrogen-Ammonia	4	4	51	210	RBC-n	0
Selenium	297	1	11	50	MCL	0
Sulfate	408	306	27,300	250,000	NSDWR	0
Zinc	31	20	270	2,000	LTHA	0

Notes: Analyte names are exactly as they appear in the IDEQ database. Detection limits were not provided for these chemicals.
The screening value listed for chromium is based on toxicity data for hexavalent chromium.
Abbreviations for health-based screening values follow:
CREG = ATSDR Cancer Risk Evaluation Guide
EMEG = ATSDR Environmental Media Evaluation Guide (values are for children's exposure of chronic [c] or intermediate [i] duration)
EAL = EPA Action Level for lead in drinking water
LTHA = EPA Lifetime Health Advisory for Drinking Water
MCL = EPA Maximum Contaminant Level for Drinking Water
NSDWR = EPA National Safe Drinking Water Regulation, secondary drinking water standard (not health-based)
RBC-n = EPA Region III Risk-Based Concentration for non-cancer health outcomes
RMEG = Reference Dose Evaluation Guide (the value in this table is for children's exposure

Table C14 – Summary of Groundwater Sampling Data, Above Screening Values (SV), Collected in the Canyon Creek and Ninemile Creek Drainages east of the Box

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	258	82	ND–18.2	LOC1 (4/4/98)	1.8	2.8	4	RMEG-c	37 (14.3%)
Arsenic	350	65	ND–250	LOC2 (11/6/96)	6.9	21	0.02	CREG	65 (18.6%)
Cadmium	414	369	ND–2,551	LOC2 (11/6/96)	150	240	2	EMEG-cc	346 (83.6%)
Copper	269	100	ND–573	LOC3 (12/3/98)	20	74	300	EMEG-ci	6 (2.2%)
Lead	416	352	ND–54,894	LOC2 (11/6/96)	1,200	4,500	15	EAL	242 (58.2%)
Manganese	255	132	ND–8,030	LOC4 (12/8/98)	300	1,030	500	RMEG-c	38 (14.9%)
Nitrite	79	6	ND–1,200	LOC3 (12/3/98)	88	180	1,000	MCL	2 (2.5%)
Silver	259	3	ND–527	LOC4 (12/8/98)	4.5	33	50	RMEG-c	1 (0.4%)
Sodium	253	253	751–44,300	LOC5 (12/1/99)	3,600	4,100	20,000	DWEL	2 (0.8%)
Thallium	259	12	ND–0.75	LOC6 (12/3/98)	0.2	0.2	0.5	LTHA	1 (0.4%)
Zinc	413	401	ND–172,400	LOC2 (10/18/95)	20,300	28,600	2,000	LTHA	289 (70%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Table summarizes all groundwater sampling results in the URS database. The majority of the sampling was conducted in monitoring wells.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = along Canyon Creek, at Burke; LOC2 = unspecified location along Canyon Creek; LOC3 = along Ninemile Creek, roughly 1 mile upstream from Wallace; LOC4 = along Canyon Creek, at Woodland Park; LOC5 = along Canyon Creek, near confluence with South Fork CdA River; LOC6 = along Canyon Creek, between Gem and Burke.

Table C15 – Summary of Groundwater Sampling Data Collected in the Pine Creek Drainage Basin

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (μg/L)	Location (Date) of Highest Concentration	Average Conc. (μg/L)	Standard Deviation (μg/L)	SV (μg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	24	19	ND–8.4	LOC1 (12/2/98)	5.0	3.2	4	RMEG-c	14 (58.3%)
Arsenic	24	2	ND–4	LOC2 (7/27/94)	0.9	0.7	0.02	CREG	2 (8.3%)
Cadmium	24	11	ND–97.8	LOC3 (7/27/94)	5.7	20	2	EMEG-cc	4 (16.7%)
Chromium	24	3	ND–397	LOC4 (7/27/94)	32	100	30	RMEG-c	2 (8.3%)
Lead	24	9	ND–16.6	LOC4 (7/27/94)	2.5	4.6	15	EAL	1 (4.2%)
Manganese	24	16	ND–1,390	LOC5 (7/29/94)	100	280	500	RMEG-c	1 (4.2%)
Nickel	24	11	ND–637	LOC4 (7/27/94)	41	130	100	LTHA	2 (8.3%)
Zinc	24	24	26.2–10,200	LOC3 (7/27/94)	1,200	2,300	2,000	LTHA	5 (20.8%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Table summarizes all groundwater sampling results in the URS database. The majority of the sampling was conducted in monitoring wells.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = unspecified location in Pine Creek drainage; LOC2 = downgradient of Denver Creek tailings pile; LOC3 = downgradient of Nabob Mill site; LOC4 = monitoring well at the Amy-Matchless Mill site; LOC5 = near the Upper Constitution rock pile.

Table C16a – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 1: Moon Creek Drainage (see Appendix B.3.1.1)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	5	2	ND–0.42	LOC1 (11/5/97)	3.5	6.2	0.02	CREG	2 (40.0%)
Cadmium	175	155	ND–5	LOC2 (1/1/97)	0.7	0.5	2	EMEG-cc	3 (1.7%)
Lead	180	103	ND–80	LOC1 (8/14/95)	3.4	7.3	15	EAL	3 (1.7%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = mouth of Moon Creek, near confluence with the South Fork CdA River; LOC2 = upstream location in Moon Creek.

Table C16b – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 2: Big Creek Drainage (see Appendix B.3.1.2)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	4	4	5.8–7.3	LOC1 (11/5/97)	6.5	0.8	4	RMEG-c	4 (100.0%)
Arsenic	9	2	ND–1.2	LOC1 (11/5/97)	8.4	7.2	0.02	CREG	2 (22.2%)
Cadmium	20	8	ND–6	LOC2 (1/1/97)	2.0	2.3	2	EMEG-cc	7 (35.0%)
Lead	15	5	ND–28	LOC1 (5/25/99)	4.9	7.2	15	EAL	1 (6.7%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = Big Creek, south of Frontage Road bridge; LOC2 = cadmium concentrations at 6 µg/L were observed in three separate samples, one each from the main stem, west fork, and east fork of Big Creek.

Table C16c – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 3: Ninemile Creek Drainage (see Appendix B.3.1.3)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	133	23	ND–1	LOC1 (11/15/98)	0.5	0.3	0.02	CREG	23 (17.3%)
Cadmium	757	728	ND–92	LOC2 (11/15/94)	25	17	2	EMEG-cc	664 (87.7%)
Lead	764	728	ND–4,260	LOC2 (11/15/97)	85	230	15	EAL	612 (80.1%)
Manganese	142	121	ND–1,020	LOC1 (11/15/98)	120	170	500	RMEG-c	8 (5.6%)
Thallium	134	1	ND–1.6	LOC3 (11/17/98)	0.3	0.2	0.5	LTHA	1 (0.7%)
Zinc	764	751	ND–18,000	LOC3 (12/6/98)	4,300	3,200	2,000	LTHA	595 (77.9%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = near the base of a tailings impoundment in Ninemile Creek; LOC2 = east fork of Ninemile Creek; LOC3 = near former mill site in Ninemile Creek.

Table C16d – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 4: Canyon Creek Drainage (see Appendix B.3.1.4)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	184	167	ND–85.1	LOC1 (11/12/98)	5.4	9.2	4	RMEG-c	100 (54.4%)
Arsenic	185	66	ND–2.7	LOC2 (11/10/97)	0.6	0.4	0.02	CREG	66 (35.7%)
Cadmium	1,023	915	ND–408	LOC3 (4/17/96)	9.1	20	2	EMEG-cc	749 (73.2%)
Copper	188	60	ND–1,020	LOC2 (12/3/99)	7.2	74	300	EMEG-ci	1 (0.5%)
Lead	1,027	942	ND–2,920	LOC4 (3/28/96)	64	220	15	EAL	620 (60.4%)
Manganese	197	170	ND–39,000	LOC2 (5/24/99)	250	2,800	500	RMEG-c	2 (1.0%)
Thallium	187	5	ND–1.6	LOC2 (1/13/98)	0.2	0.2	0.5	LTHA	3 (1.6%)
Zinc	1,030	1,017	ND–7,240	LOC5 (11/25/98)	1,200	1,300	2,000	LTHA	223 (21.7%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = small tributary to Canyon Creek, at Burke; LOC2 = Canyon Creek, between Gem and Burke; LOC3 = Canyon Creek, between Woodland Park and Gem; LOC4 = Canyon Creek, at Woodland Park; LOC5 = Canyon Creek, between Wallace and Woodland Park.

Table C16e – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 5: Other Tributaries Flowing into the South Fork CdA River at Locations Between Elizabeth Park and Wallace (see Appendix B.3.1.5)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	83	56	ND–7.5	LOC1 (11/8/97)	1.3	1.7	4	RMEG-c	8 (9.6%)
Arsenic	90	36	ND–7.3	LOC2 (5/9/98)	1.8	3.7	0.02	CREG	36 (40.0%)
Cadmium	158	30	ND–12.7	LOC3 (11/5/97)	0.8	2.1	2	EMEG-cc	14 (8.9%)
Lead	156	71	ND–500	LOC4 (5/22/99)	4.9	40	15	EAL	4 (2.6%)
Mercury	90	1	ND–2.6	LOC5 (11/7/97)	0.3	0.7	2	MCL	1 (1.1%)
Sodium	93	93	643–39,600	LOC3 (5/8/98)	2,700	5,600	20,000	DWEL	2 (2.2%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Lake Creek; LOC2 = Placer Creek; LOC3 = Prospect Gulch; LOC4 = Terror Gulch; LOC5 = Twomile Creek.

Table C16f – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 6: Other Tributaries Flowing into the South Fork CdA River at Locations Upstream of Wallace (see Appendix B.3.1.6)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	101	29	ND–19	LOC1 (11/9/97)	0.8	2.1	4	RMEG-c	2 (2.0%)
Arsenic	101	33	ND–2.7	LOC2 (11/9/97)	0.7	1.5	0.02	CREG	33 (32.7%)
Cadmium	134	49	ND–17	LOC3 (3/9/99)	2.4	4.3	2	EMEG-cc	35 (26.1%)
Lead	127	88	ND–460	LOC3 (4/24/98)	10	42	15	EAL	23 (18.1%)
Thallium	102	2	ND–0.92	LOC1 (11/9/97)	0.1	0.1	0.5	LTHA	2 (2.0%)
Zinc	128	77	ND–2,400	LOC3 (11/24/98)	320	600	2,000	LTHA	4 (3.1%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Slaughterhouse Gulch; LOC2 = Gold Hunter Gulch; LOC3 = Grouse Gulch.

Table C16g – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 7: South Fork CdA River at Locations Between Elizabeth Park and Wallace (see Appendix B.3.1.7)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	67	59	ND–8	LOC1 (5/25/99)	2.4	1.8	4	RMEG-c	10 (14.9%)
Arsenic	64	37	ND–13	LOC1 (5/25/99)	0.7	1.6	0.02	CREG	37 (57.8%)
Cadmium	848	848	1.3–60	LOC1 (6/25/97)	7.6	3.9	2	EMEG-cc	817 (96.3%)
Lead	850	823	ND–2,160	LOC2 (12/18/97)	35	120	15	EAL	401 (47.2%)
Manganese	104	104	14–790	LOC3 (5/24/99)	87	140	500	RMEG-c	3 (2.9%)
Zinc	849	849	181–2,920	LOC1 (10/4/91)	1,130	570	2,000	LTHA	74 (8.7%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = USGS station at Elizabeth Park; LOC2 = old railroad bridge in Wallace; LOC3 = Interstate 90 bridge downstream from Osburn.

Table C16h – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 8: South Fork CdA River at Locations Between Wallace and Mullan (see Appendix B.3.1.8)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	12	12	0.28–0.57	LOC1 (5/10/98)	0.4	0.1	0.02	CREG	12 (100.0%)
Cadmium	235	227	ND–8	LOC2 (10/3/91)	1.0	0.7	2	EMEG-cc	11 (4.7%)
Lead	233	189	ND–588	LOC3 (5/15/97)	9.3	39	15	EAL	12 (5.2%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = approximately 2 miles upstream of Wallace; LOC2 = immediately upstream from confluence with Canyon Creek; LOC3 = approximately 1 mile upstream of Wallace.

Table C16i – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 9: South Fork CdA River at Locations Upstream of Mullan (see Appendix B.3.1.9)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	12	7	ND–0.49	LOC1	0.5	0.3	0.02	CREG	7 (58.3%)
Cadmium	118	11	ND–4.4	LOC1	0.3	0.6	2	EMEG-cc	5 (4.2%)
Lead	126	50	ND–32.8	LOC1	2.3	3.7	15	EAL	1 (0.8%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration is greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = the South Fork CdA River in Mullan.

Table C16j – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the South Fork CdA Watershed East of the Box; Sub-area 10: Common Use Area at Elk Creek Pond (see Appendix B.3.1.10)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	4	1	ND–35	CUA81 (8/24/98)	10	17	4	RMEG-c	1 (25.0%)
Arsenic	5	5	5.5–32	CUA81 (8/24/98)	17	12	0.02	CREG	5 (100.0%)
Cadmium	5	5	5.8–60.3	CUA81 (8/24/98)	26	22	2	EMEG-cc	5 (100.0%)
Lead	5	5	34.9–7,180	CUA81 (8/24/98)	1,600	3,100	15	EAL	5 (100.0%)
Manganese	5	5	122–8,570	CUA81 (8/24/98)	2,300	3,600	500	RMEG-c	3 (60.0%)
Mercury	5	4	ND–3.5	CUA81 (8/24/98)	0.9	1.5	2	MCL	1 (20.0%)
Sodium	5	5	35,200–36,300	CUA81 (8/24/98)	35,800	430	20,000	DWEL	5 (100.0%)
Vanadium	5	5	2.8–40.7	CUA81 (8/24/98)	15	16	30	EMEG-ci	1 (20.0%)
Zinc	5	5	738–5,650	CUA81 (8/24/98)	3,000	2,100	2,000	LTHA	3 (60.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
All sampling occurred at Elk Creek Pond, which is known as common use area #81. Location of highest concentration is listed as CUA81.
Surface water samples in the CUAs were collected after field personnel disturbed the local sediments. Thus, these results are not directly comparable to the surface water sampling data in Tables 16 and 17.

Table C17a – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed East of the Box; Sub-area 1: Prichard Creek Drainage (see Appendix B.3.2.1)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	95	9	ND–0.46	LOC1 (5/11/98)	0.9	0.5	0.02	CREG	9 (9.5%)
Cadmium	123	50	ND–15	LOC2 (1/1/97)	1.1	2.1	2	EMEG-cc	9 (7.3%)
Chromium	96	14	ND–71	LOC3 (5/9/98)	5.0	8.3	30	RMEG-c	1 (1.0%)
Lead	117	64	ND–94.6	LOC4 (5/8/98)	4.7	14	15	EAL	7 (6.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = Granite Gulch, upstream of confluence with Prichard Creek; LOC2 = Prichard Creek, downstream from a tailings pile; LOC3 = Prichard Creek, upstream of confluence with Wesp Gulch; LOC4 = Tributary Creek, in East Fork Eagle Creek drainage.

Table C17b – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed East of the Box; Sub-area 2: Beaver Creek Drainage (see Appendix B.3.2.2)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	33	5	ND–1.6	LOC1 (5/6/98)	3.3	5.4	0.02	CREG	5 (15.2%)
Cadmium	36	24	ND–21	LOC2 (1/1/97)	2.8	4.3	2	EMEG-cc	12 (33.3%)
Chromium	39	6	ND–150	LOC3 (1/1/97)	7.7	24	30	RMEG-c	1 (2.6%)
Lead	33	17	ND–24	LOC3 (1/1/97)	2.8	4.6	15	EAL	1 (3.0%)
Zinc	40	28	ND–3,100	LOC2 (1/1/97)	370	700	2,000	LTHA	2 (5.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = Pony Gulch, upstream of confluence with Beaver Creek; LOC2 = near a former mill in the Beaver Creek drainage; LOC3 = tailings pond in the Beaver Creek drainage.

Table C17c – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed East of the Box; Sub-area 3: North Fork CdA River (see Appendix B.3.2.3)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	17	3	ND–2	LOC1 (5/25/99)	2.8	5.6	0.02	CREG	3 (17.6%)
Cadmium	67	3	ND–7	LOC2 (1/1/97)	0.7	1.1	2	EMEG-cc	2 (3.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = North Fork CdA River at Enaville; LOC2 = downstream from a mining prospect at an unspecified location in the North Fork CdA drainage.

Table C18a – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed West of the Box; Sub-area 1: Pine Creek Drainage (see Appendix B.3.3.1)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	89	21	ND–9.3	LOC1 (11/16/98)	2.9	6.8	4	RMEG-c	2 (2.2%)
Arsenic	150	15	ND–11.7	LOC2 (7/15/94)	1.4	1.4	0.02	CREG	15 (10.0%)
Cadmium	419	257	ND–32.7	LOC3 (6/1/93)	3.0	4.6	2	EMEG-cc	156 (37.2%)
Lead	427	291	ND–254	LOC2 (7/15/94)	6.2	19	15	EAL	26 (6.1%)
Manganese	161	61	ND–704	LOC4 (11/12/97)	13	71	500	RMEG-c	2 (1.2%)
Zinc	427	415	ND–12,900	LOC1 (6/1/93)	1,040	1,700	2,000	LTHA	73 (17.1%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Pine Creek, near confluence with the South Fork CdA River; LOC2 = downstream from a mill site on Nabob Creek; LOC3 = downstream from a mine dump site in the Pine Creek drainage; LOC4 = Nabob Creek, before its confluence with Pine Creek.

Table C18b – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed West of the Box; Sub-area 2: South Fork CdA River West of the Box (see Appendix B.3.3.2)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	27	3	ND–1.5	LOC1 (10/1/92)	2.2	2.1	0.02	CREG	3 (11.1%)
Cadmium	27	23	ND–40	LOC1 (1/19/99)	11	7.8	2	EMEG-cc	23 (85.2%)
Lead	27	19	ND–21.9	LOC1 (8/1/92)	4.7	4.7	15	EAL	1 (3.7%)
Zinc	27	27	266–2,910	LOC1 (10/1/88)	1,600	830	2,000	LTHA	10 (37.0%)

Notes: Source of data: TerraGraphics 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration and standard deviation are both greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = Monitoring station SF-8, located on the South Fork CdA River between Enaville and Pinehurst.

Table C18c – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed West of the Box; Sub-area 3: CdA River, from Enaville to Harrison (see Appendix B.3.3.3)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	4	1	ND–0.46	LOC1 (11/11/97)	0.5	0.1	0.02	CREG	1 (25.0%)
Cadmium	411	403	ND–5.6	LOC2 (12/13/96)	2.1	0.9	2	EMEG-cc	182 (44.3%)
Lead	411	404	ND–430	LOC1 (4/21/99)	15	39	15	EAL	73 (17.8%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
For arsenic, the average concentration is greater than the highest detected concentration. This results from the fact that several non-detect observations had detection limits much higher than the highest detected concentration. For these samples, even one-half the detection limit was greater than the highest measured concentration.
Codes for locations (LOCs): LOC1 = CdA River at Harrison; LOC2 = CdA River at Cataldo.

Table C19 – Summary of Surface Water Sampling Data Collected in Rivers, Creeks, Ponds, and Gulches; Locations in the CdA River Watershed West of the Box; Sub-area 4: Common Use Areas Along the CdA River (see Appendix B.3.3.4)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	100	99	ND–123,000	CUA48 (8/15/98)	7,300	14,500	20,000	EMEG-ci	6 (6.0%)
Antimony	103	75	ND–39.5	CUA53 (8/30/98)	14	9.0	4	RMEG-c	73 (70.9%)
Arsenic	100	99	ND–600	CUA48 (8/15/98)	74	74	0.02	CREG	99 (99.0%)
Barium	100	99	ND–3,280	CUA48 (8/15/98)	290	410	700	RMEG-c	7 (7.0%)
Beryllium	106	26	ND–9.1	CUA48 (8/15/98)	0.8	1.1	4	MCL	1 (0.9%)
Cadmium	99	98	ND–1,200	CUA48 (8/15/98)	64	130	2	EMEG-cc	98 (99.0%)
Chromium	102	83	ND–151	CUA48 (8/15/98)	10	17	30	RMEG-c	4 (3.9%)
Cobalt	100	85	ND–160	CUA48 (8/15/98)	13	17	100	EMEG-ci	1 (1.0%)
Copper	100	99	ND–2,810	CUA48 (8/15/98)	180	300	300	EMEG-ci	12 (12.0%)
Lead	100	100	2.9–81,500	CUA48 (8/15/98)	16,600	15,700	15	EAL	99 (99.0%)
Manganese	99	99	5.2–84,900	CUA48 (8/15/98)	16,700	14,700	500	RMEG-c	98 (99.0%)
Mercury	100	95	ND–43.9	CUA48 (8/15/98)	3.8	5.6	2	MCL	53 (53.0%)
Nickel	102	65	ND–219	CUA48 (8/15/98)	16	25	100	LTHA	1 (1.0%)
Silver	105	68	ND–308	CUA48 (8/15/98)	17	33	50	RMEG-c	6 (5.7%)
Thallium	103	12	ND–54	CUA57 (9/1/98)	0.7	5.3	0.5	LTHA	7 (6.8%)
Vanadium	103	50	ND–172	CUA48 (8/15/98)	11	20	30	EMEG-ci	10 (9.7%)
Zinc	100	100	589–116,000	CUA48 (8/15/98)	8,000	12,600	2,000	LTHA	85 (85.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations.
Codes for common use areas (CUAs): CUA48 = river mile 145, between Cave Lake and Killarney Lake; CUA53 = beach below Ward Bridge; CUA57 = beach upstream from quarry.
Surface water samples in the CUAs were collected after field personnel disturbed the local sediments. Thus, these results are not directly comparable to the surface water sampling data in Tables 16 and 17.

Table C20 – Surface Water Sampling Data for Metals Found Above Screening Values (SV) in Common Use Areas in the Lateral Lakes

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Metals Found Above Screening Values (SV) at Rainy Hill Picnic Area on Medicine Lake									
Antimony	5	5	4.1–21.4	CUA47 (8/9/98)	10	7	4	RMEG-c	5 (100.0%)
Arsenic	5	5	17.3–173	CUA47 (8/9/98)	82	69	0.02	CREG	5 (100.0%)
Cadmium	5	5	2.8–15.7	CUA47 (8/9/98)	9	6	2	EMEG-cc	5 (100.0%)
Lead	5	5	452–3,280	CUA47 (8/9/98)	1,600	1,200	15	EAL	5 (100.0%)
Manganese	5	5	1,120–5,310	CUA47 (8/9/98)	3,000	2,000	500	RMEG-c	5 (100.0%)
Metals Found Above Screening Values (SV) on the Western Shore of Thompson Lake									
Arsenic	5	5	3.4–6.2	CUA38 (9/2/98)	4.4	1.1	0.02	CREG	5 (100.0%)
Cadmium	5	2	ND–2.9	CUA38 (9/2/98)	1.2	1.1	2	EMEG-cc	1 (20.0%)
Lead	5	5	166–876	CUA38 (9/2/98)	370	300	15	EAL	5 (100.0%)
Manganese	5	5	357–961	CUA38 (9/2/98)	630	230	500	RMEG-c	4 (80.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA47 = Rainy Hill Picnic Area on Medicine Lake; CUA38 = the western shore of Thompson Lake.
Surface water samples in the CUAs were collected after field personnel disturbed the local sediments. Thus, these results are not directly comparable to the surface water sampling data in Tables 16 and 17.

Table C21 – Surface Water Sampling Data for Metals Found Above Screening Values (SV) in CUAs along CdA Lake

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Arsenic	110	59	ND–15.3	CUA18 (8/6/98)	2.0	2.4	0.02	CREG	59 (53.6%)
Cadmium	111	67	ND–16.6	CUA29 (8/31/98)	2.1	2.7	2	EMEG-cc	34 (30.6%)
Lead	111	107	ND–469	CUA18 (8/6/98)	50	85	15	EAL	65 (58.6%)
Manganese	111	110	ND–970	CUA29 (8/31/98)	140	160	500	RMEG-c	5 (4.5%)
Thallium	113	1	ND–6.2	CUA11 (8/11/98)	0.2	0.6	0.5	LTHA	1 (0.9%)
Vanadium	111	32	ND–82.9	CUA29 (8/31/98)	6.0	11	30	EMEG-ci	3 (2.7%)
Zinc	111	111	41.4–2,250	CUA19 (8/11/98)	310	350	2,000	LTHA	2 (1.8%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
All samples were collected after field personnel vigorously disturbed sediments in the common use areas.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA11 = Tubbs Hill; CUA18 = Harrison Beach; CUA19 = Cougar Bay; CUA29 = Spokane Point (on reservation).

Table C22 – Surface Water Sampling Data for Metals Found Above Screening Values (SV) in Common Use Areas along the Spokane River

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	48	48	89.8–33,300	CUA6 (8/3/98)	6,400	7,100	20,000	EMEG-ci	4 (8.3%)
Antimony	49	34	ND–5.9	CUA7 (8/2/98)	1.1	0.9	4	RMEG-c	1 (2.0%)
Arsenic	45	20	ND–20.8	CUA21 (8/3/98)	3.9	4.3	0.02	CREG	20 (44.4%)
Barium	49	49	9.3–941	CUA21 (8/3/98)	110	170	700	RMEG-c	2 (4.1%)
Cadmium	48	34	ND–47.9	CUA21 (8/3/98)	5.9	9.7	2	EMEG-cc	29 (60.4%)
Lead	47	47	1.3–917	CUA21 (8/3/98)	130	180	15	EAL	42 (89.4%)
Manganese	46	46	10.1–6,980	CUA21 (8/3/98)	630	1,400	500	RMEG-c	9 (19.6%)
Thallium	47	2	ND–2.8	CUA1 (8/6/98)	0.2	0.4	0.5	LTHA	1 (2.1%)
Vanadium	48	32	ND–76.8	CUA21 (8/3/98)	14	17	30	EMEG-ci	7 (14.6%)
Zinc	46	46	52.6–5,720	CUA21 (8/3/98)	820	1,100	2,000	LTHA	3 (6.5%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA1 = North Idaho College Beach along the Spokane River; CUA6 = Black Bay on Spokane River, near Post Falls; CUA7 = Bureau of Land Management Pump Station on Spokane River at Post Falls; CUA21 = Blackwell Island in the Spokane River in Coeur d’Alene.
Surface water samples in the CUAs were collected after field personnel disturbed the local sediments. Thus, these results are not directly comparable to the surface water sampling data in Tables 16 and 17.

Table C23 – Summary of Surface Water Sampling Data Collected in Adits, Outfalls, Seeps, and Other Mine Discharges: Locations in the South Fork CdA Watershed East of the Box

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	144	50	ND–331	LOC1 (3/26/98)	9.3	31	4	RMEG-c	16 (11.1%)
Arsenic	185	95	ND–100	LOC2 (3/23/98)	9.3	13	0.02	CREG	95 (51.4%)
Barium	189	183	ND–1,430	LOC3 (11/19/97)	68	160	700	RMEG-c	2 (1.1%)
Cadmium	787	468	ND–1,990	LOC1 (7/30/96)	20	140	2	EMEG-cc	354 (45.0%)
Cobalt	109	23	ND–178	LOC4 (11/14/97)	8	26	100	EMEG-ci	2 (1.8%)
Copper	231	100	ND–551	LOC3 (5/18/98)	20	68	300	EMEG-ci	5 (2.2%)
Lead	799	696	ND–2,010	LOC5 (11/14/97)	75	160	15	EAL	596 (74.6%)
Manganese	227	195	ND–260,000	LOC2 (3/23/98)	3,700	24,700	500	RMEG-c	47 (20.7%)
Nickel	193	95	ND–306	LOC4 (11/14/97)	14	39	100	LTHA	4 (2.1%)
Zinc	930	854	ND–540,000	LOC4 (5/16/98)	3,300	33,300	2,000	LTHA	62 (6.7%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = outfall from mine site east of Bunker Hill; LOC2 = unspecified effluent to surface water; LOC3 = Adit from mine site on tributary to South Fork CdA River; LOC4 = seep from mill site along Ninemile Creek; LOC5 = adit from mine site along Ninemile Creek.

Table C24 – Summary of Surface Water Sampling Data Collected in Adits, Outfalls, Seeps, and Other Mine Discharges: Locations in the North Fork CdA Watershed and CdA River Drainage

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (µg/L)	Location (Date) of Highest Concentration	Average Conc. (µg/L)	Standard Deviation (µg/L)	SV (µg/L)	Type of SV	Number (and Percent) of Samples > SV
Antimony	62	15	ND–267	LOC1 (11/16/97)	8.7	45	4	RMEG-c	2 (3.2%)
Arsenic	150	62	ND–380	LOC2 (1/1/97)	9.2	39	0.02	CREG	62 (41.3%)
Cadmium	202	141	ND–226	LOC1 (8/1/93)	10	31	2	EMEG-cc	93 (46.0%)
Chromium	158	47	ND–61	LOC3 (1/1/97)	6.2	7	30	RMEG-c	1 (0.6%)
Copper	182	87	ND–1,070	LOC1 (8/1/93)	24	99	300	EMEG-ci	3 (1.6%)
Lead	169	113	ND–2,560	LOC1 (8/1/93)	65	320	15	EAL	35 (20.7%)
Manganese	182	143	ND–3,070	LOC1 (8/1/93)	210	500	500	RMEG-c	24 (13.2%)
Nickel	156	86	ND–122	LOC1 (8/1/93)	18	21	100	LTHA	2 (1.3%)
Zinc	202	173	ND–73,600	LOC1 (8/1/93)	3,200	10,500	2,000	LTHA	45 (22.3%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. An SV for hexavalent chromium was used to evaluate chromium levels.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = mine adit in the Pine Creek drainage; mine adit in the mountains surrounding CdA Lake; LOC3 = mine adit in the Beaver Creek drainage.

Table C25 – Summary of Surface Sediment Sampling Data: Locations in the South Fork CdA River Watershed East of the Box

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	52	52	1,190–15,000	LOC1 (1/17/98)	4,400	2,900	4,000	EMEG-ip	20 (38.5%)
Antimony	53	27	ND–623	LOC2 (12/12/97)	31	95	20	RMEG-c	16 (30.2%)
Arsenic	53	53	1.91–214	LOC3 (5/19/98)	31	41	6	BKGD	44 (83.0%)
Cadmium	64	62	ND–132	LOC4 (1/14/98)	18	27	10	EMEG-cc	26 (40.6%)
Cobalt	53	53	2.7–43.6	LOC1 (1/17/98)	14	9	20	EMEG-ip	11 (20.8%)
Copper	57	57	16.2–823	LOC5 (12/16/97)	130	140	60	EMEG-ip	38 (66.7%)
Iron	57	57	6,160–124,000	LOC3 (5/19/98)	35,000	24,000	23,000	RBC-n	38 (66.7%)
Lead	61	61	31.1–67,100	LOC4 (1/14/98)	4,500	9,100	400	SSL	51 (83.6%)
Manganese	52	52	330–15,700	LOC3 (12/16/97)	2,900	2,900	3,000	RMEG-c	20 (38.5%)
Mercury	58	49	ND–26	LOC3 (5/19/98)	1.6	4.0	4	EMEG-ip	5 (8.6%)
Thallium	52	16	ND–14.4	LOC3 (12/16/97)	1.0	2.1	5.5	RBC-n	2 (3.8%)
Vanadium	52	51	ND–34.8	LOC1 (1/17/98)	8.1	6.4	6	EMEG-ip	24 (46.2%)
Zinc	61	61	66.4–22,400	LOC4 (1/14/98)	3,300	4,300	600	EMEG-ip	50 (82.0%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
An SV for mercuric chloride is used to screen sediment concentrations of mercury.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Bed of Ninemile Creek, roughly 6 miles upstream from South Fork CdA River; LOC2 = Unspecified location along Big Creek; LOC3 = Unspecified location east of Osburn; LOC4 = Bed of Canyon Creek, roughly 3 miles upstream from South Fork CdA River; LOC5 = Bed of South Fork CdA River, near mouth of Big Creek.

Table C26a – Summary of Surface Sediment Sampling Data in Locations West of the Box: Pine Creek Drainage

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	46	46	1,460–25,400	LOC1 (7/15/94)	5,800	4,600	4,000	EMEG-ip	30 (65.2%)
Antimony	46	21	ND–29	LOC2 (12/11/97)	7.3	7.2	20	RMEG-c	1 (2.2%)
Arsenic	45	42	ND–262	LOC3 (7/16/94)	50	69	6	BKGD	35 (77.8%)
Cadmium	46	38	ND–18.2	LOC4 (7/16/94)	3.9	4.8	10	EMEG-cc	9 (19.6%)
Cobalt	45	44	ND–63.1	LOC5 (7/15/94)	11	13	20	EMEG-ip	5 (11.1%)
Copper	45	44	ND–284	LOC1 (7/15/94)	47	51	60	EMEG-ip	9 (20.0%)
Iron	44	44	6,270–45,800	LOC6 (7/15/94)	20,400	8,300	23,000	RBC-n	11 (25.0%)
Lead	45	45	5.16–6,680	LOC7 (7/16/94)	1,040	1,500	400	SSL	22 (48.9%)
Vanadium	46	45	ND–29.2	LOC1 (7/15/94)	7.9	5.5	6	EMEG-ip	23 (50.0%)
Zinc	46	46	10–6,930	LOC4 (7/16/94)	1,200	1,400	600	EMEG-ip	26 (56.5%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Red Cloud Creek, near mill site; LOC2 = Pine Creek, one river mile upstream of Main Street bridge; LOC3 = Highland Creek, near mill site; LOC4 = Pine Creek, downgradient of Upper Constitution Mill; LOC5 = Pine Creek downgradient of Nabob Mill; LOC6 = Nabob Creek, downgradient from Nabob Mill; LOC7 = Pine Creek drainage, seep at mill site.

Table C26b – Summary of Surface Sediment Sampling Data in Areas West of the Box: CdA River, from Enaville to Harrison

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	191	191	0.41–93,000	LOC1 (1/1/00)	26,300	27,100	4,000	EMEG-ip	129 (67.5%)
Antimony	194	189	ND–133	LOC1 (1/1/00)	37	28	20	RMEG-c	142 (73.2%)
Arsenic	748	632	ND–634	LOC2 (7/18/95)	97	105	6	BKGD	621 (83.0%)
Cadmium	788	777	ND–200	LOC3 (1/1/00)	20	17	10	EMEG-cc	342 (43.4%)
Cobalt	135	135	2.42–24.9	LOC4 (11/17/97)	9.9	4.2	20	EMEG-ip	2 (1.5%)
Copper	241	241	7.47–390	LOC2 (1/1/00)	103	71	60	EMEG-ip	167 (69.3%)
Iron	748	748	2.32–164,000	LOC5 (1/1/00)	47,500	36,200	23,000	RBC-n	481 (64.3%)
Lead	796	796	20.3–35,600	LOC1 (12/14/97)	3,500	3,300	400	SSL	684 (85.9%)
Manganese	747	747	25.5–16,100	LOC3 (8/14/95)	3,900	3,700	3,000	RMEG-c	348 (46.6%)
Mercury	215	186	ND–12	LOC1 (1/1/00)	2.2	2.0	4	EMEG-ip	29 (13.5%)
Vanadium	63	63	4.74–39.9	LOC6 (11/13/97)	15	6.9	6	EMEG-ip	60 (95.2%)
Zinc	795	795	14.4–14,100	LOC1 (1/1/00)	2,200	1,800	600	EMEG-ip	624 (78.5%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = CdA River, between Springston and Medimont; LOC2 = CdA River, between 4th of July Creek and Medimont; LOC3 = CdA River, at the Mission Flats area; LOC4 = CdA River, at Medimont; LOC5 = CdA River, at Harrison; LOC6 = CdA River, near Black Lake.
An SV for mercuric chloride was used to evaluate mercury levels.

Table C27a – Summary of Surface Sediment Sampling Data: CUAs along the CdA River and Selected Tributaries; Review of Submerged ("Wet") Samples

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	104	104	1,330–17,600	CUA56 (9/1/98)	3,700	2,300	4,000	EMEG-ip	34 (32.7%)
Antimony	105	99	ND–73.7	CUA63 (8/27/98)	27	14	20	RMEG-c	72 (68.6%)
Arsenic	104	104	4.3–318	CUA39 (8/14/98)	110	45	6	BKGD	102 (98.1%)
Cadmium	102	102	0.38–105	CUA57 (9/1/98)	44	27	10	EMEG-cc	95 (93.1%)
Copper	103	103	7.2–490	CUA63 (8/27/98)	140	78	60	EMEG-ip	96 (93.2%)
Iron	103	103	11,400–256,000	CUA57 (9/1/98)	114,000	53,000	23,000	RBC-n	97 (94.2%)
Lead	101	101	34–16,800	CUA63 (8/27/98)	3,700	2,200	400	SSL	96 (95.0%)
Manganese	104	104	112–25,500	CUA57 (9/1/98)	11,000	6,000	3,000	RMEG-c	97 (93.3%)
Mercury	104	101	ND–20.2	CUA63 (8/27/98)	2.4	2.1	4	EMEG-ip	7 (6.7%)
Thallium	72	9	ND–9.3	CUA53 (8/30/98)	1.1	2.2	5.5	RBC-n	7 (9.7%)
Vanadium	106	85	ND–26.6	CUA45 (9/9/98)	5.3	4.6	6	EMEG-ip	43 (40.6%)
Zinc	102	102	195–21,800	CUA57 (9/1/98)	7,300	4,900	600	EMEG-ip	96 (94.1%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (CUAs): CUA39 = Long Beach near Springston (CdA River mile 135); CUA45 = Medimont Boat Ramp; CUA53 = beach below Ward Bridge (upstream from Lane); CUA56 = RV Park across from Blackrock Gulch; CUA57 = beach upstream from Quarry (across CdA River from Blackrock Gulch); CUA63 = Bull Run Peak Beach.
An SV for mercuric chloride was used to evaluate mercury levels.

Table C27b – Summary of Surface Sediment Sampling Data: CUAs along the CdA River and Selected Tributaries; Review of Shoreline (“Dry”) Samples

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	98	98	1,520–7,250	CUA68 (8/26/98)	3,400	1,200	4,000	EMEG-ip	21 (21.4%)
Antimony	97	91	ND–64.3	CUA77 (8/13/98)	28	12	20	RMEG-c	66 (68.0%)
Arsenic	99	99	63.5–375	CUA60 (8/15/98)	150	46	6	BKGD	99 (100.0%)
Cadmium	98	98	4.8–94.4	CUA57 (9/1/98)	37	19	10	EMEG-cc	93 (94.9%)
Copper	98	98	50.9–325	CUA57 (9/1/98)	150	60	60	EMEG-ip	96 (98.0%)
Iron	99	99	39,100–217,000	CUA60 (8/15/98)	124,000	38,000	23,000	RBC-n	99 (100.0%)
Lead	98	98	1,460–9,070	CUA63 (8/27/98)	4,200	1,300	400	SSL	98 (100.0%)
Manganese	100	100	2,980–26,400	CUA58 (8/27/98)	11,700	4,700	3,000	RMEG-c	99 (99.0%)
Mercury	96	96	0.3–15.2	CUA60 (8/15/98)	3.2	1.9	4	EMEG-ip	12 (12.5%)
Thallium	77	14	ND–7.7	CUA57 (9/1/98)	1.2	2.3	5.5	RBC-n	10 (13.0%)
Vanadium	98	80	ND–13.1	CUA77 (8/13/98)	5.2	3.4	6	EMEG-ip	42 (42.9%)
Zinc	100	100	1,400–15,300	CUA57 (9/1/98)	5,800	3,100	600	EMEG-ip	100 (100.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (CUAs): CUA57 = beach upstream from Quarry (across CdA River from Blackrock Gulch); CUA58 = east end of Blackrock Gulch Marsh; CUA60 = west of Rose Lake (along CdA River); CUA63 = Bull Run Peak Beach; CUA68 = south of Old Mission State Park (along CdA River); CUA77 = confluence of North and South Fork CdA Rivers.
An SV for mercuric chloride was used to evaluate mercury levels.

Table C28a – Summary of Surface Sediment Sampling Data: CUAs Located Along the Lateral Lakes of the CdA River; Review of Submerged ("Wet") Samples

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	7	7	2,320–4,220	CUA47 (8/9/98)	3,200	640	4,000	EMEG-ip	1 (14.3%)
Antimony	7	2	ND–27.5	CUA47 (8/9/98)	6.6	11	20	RMEG-c	1 (14.3%)
Arsenic	7	7	1.5–166	CUA47 (8/9/98)	43	70	6	BKGD	2 (28.6%)
Cadmium	7	3	ND–22.3	CUA47 (8/9/98)	6.0	10	10	EMEG-cc	2 (28.6%)
Copper	7	7	2.1–89.8	CUA47 (8/9/98)	25	36	60	EMEG-ip	2 (28.6%)
Iron	7	7	4,450–112,000	CUA47 (8/9/98)	31,200	42,800	23,000	RBC-n	2 (28.6%)
Lead	7	7	18.3–3,590	CUA47 (8/9/98)	860	1,400	400	SSL	2 (28.6%)
Manganese	7	7	92.3–8,970	CUA47 (8/9/98)	2,200	3,600	3,000	RMEG-c	2 (28.6%)
Vanadium	7	7	8.8–22.3	CUA38 (9/2/98)	15	5.6	6	EMEG-ip	7 (100.0%)
Zinc	7	7	14.3–3,260	CUA47 (8/9/98)	820	1,300	600	EMEG-ip	2 (28.6%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (CUAs): CUA38 = Thompson Lake; CUA47 = Rainy Hill Picnic Area (at Medicine Lake).

Table C28b – Summary of Surface Sediment Sampling Data: Lateral Lakes of the CdA River, Excluding the CUA Sampling Data

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	15	15	3,090–71,500	LOC1 (12/4/97)	20,100	17,500	4,000	EMEG-ip	14 (93.3%)
Antimony	39	34	ND–36	LOC2 (11/23/97)	16	9.6	20	RMEG-c	16 (41.0%)
Arsenic	139	138	ND–408	LOC2 (1/1/91)	73	72	6	BKGD	137 (98.6%)
Cadmium	150	140	ND–122	LOC2 (1/1/92)	26	20	10	EMEG-cc	121 (80.7%)
Copper	149	149	17.9–426	LOC3 (1/1/91)	120	72	60	EMEG-ip	113 (75.8%)
Iron	145	145	2.08–108,000	LOC2 (11/23/97)	45,100	23,400	23,000	RBC-n	120 (82.8%)
Lead	149	148	ND–21,248	LOC4 (1/1/92)	4,500	3,600	400	SSL	139 (93.3%)
Manganese	145	145	262–8,784	LOC2 (1/1/91)	2,500	2,200	3,000	RMEG-c	45 (31.0%)
Mercury	143	133	ND–17	LOC5 (1/1/91)	2.2	1.9	4	EMEG-ip	15 (10.5%)
Vanadium	15	15	6.66–39.8	LOC6 (11/22/97)	23	10	6	EMEG-ip	15 (100.0%)
Zinc	148	148	107–11,907	LOC5 (1/1/91)	3,400	2,100	600	EMEG-ip	139 (93.9%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = Rose Lake; LOC2 = Medicine Lake; LOC3 = Bull Run Lake; LOC4 = Blue Lake; LOC5 = Swan Lake; LOC6 = Killarney Lake.
An SV for mercuric chloride was used to evaluate mercury levels.

Table C29a – Summary of Surface Sediment Sampling Data: CUAs along the Shores of CdA Lake; Review of Submerged ("Wet") Samples

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	86	86	3,130–33,200	CUA2 (8/7/98)	10,100	6,300	4,000	EMEG-ip	77 (89.5%)
Arsenic	86	83	ND–27.1	CUA24 (8/12/98)	7.5	5.3	6	BKGD	35 (40.7%)
Cadmium	87	86	ND–24.6	CUA15 (8/5/98)	3.3	3.8	10	EMEG-cc	5 (5.7%)
Cobalt	85	85	2–20.4	CUA24 (8/12/98)	6.9	3.8	20	EMEG-ip	1 (1.2%)
Copper	88	88	5.6–283	CUA16 (8/5/98)	32	44	60	EMEG-ip	9 (10.2%)
Iron	85	85	7,670–48,200	CUA19 (8/11/98)	19,700	8,500	23,000	RBC-n	23 (27.1%)
Lead	85	85	22–1,030	CUA18 (8/6/98)	120	180	400	SSL	5 (5.9%)
Vanadium	85	85	6.7–127	CUA30 (8/7/98)	29	22	6	EMEG-ip	85 (100.0%)
Zinc	86	86	153–3,440	CUA19 (8/11/98)	680	560	600	EMEG-ip	34 (39.5%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA2 = North Idaho College Beach; CUA15 and CUA16 = Different locations at Higgan's Point; CUA18 = Harrison Beach; CUA19 = Cougar Bay; CUA24 = Mica Bay; CUA30 = Fuller Landing.

Table C29b – Summary of Surface Sediment Sampling Data: CUAs along the Shores of CdA Lake; Review of Shoreline (“Dry”) Samples

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	99	99	3,320–35,200	CUA9 (8/10/98)	12,100	6,600	4,000	EMEG-ip	97 (98.0%)
Antimony	69	31	ND–55.6	CUA18 (8/6/98)	2.2	6.9	20	RMEG-c	1 (1.4%)
Arsenic	100	100	0.71–158	CUA18 (8/6/98)	11	17	6	BKGD	60 (60.0%)
Cadmium	100	95	ND–18.5	CUA9 (8/10/98)	3.1	3.3	10	EMEG-cc	4 (4.0%)
Copper	100	100	9.1–282	CUA16 (8/5/98)	31	33	60	EMEG-ip	8 (8.0%)
Iron	100	100	9,370–54,900	CUA18 (8/6/98)	19,800	6,600	23,000	RBC-n	21 (21.0%)
Lead	99	99	15.7–12,100	CUA18 (8/6/98)	360	1,300	400	SSL	14 (14.1%)
Manganese	99	99	98.8–4,780	CUA18 (8/6/98)	520	590	3,000	RMEG-c	1 (1.0%)
Vanadium	100	100	8.9–84.7	CUA18 (8/6/98)	23	11	6	EMEG-ip	100 (100.0%)
Zinc	98	98	45.1–4,310	CUA18 (8/6/98)	610	580	600	EMEG-ip	38 (38.8%)

Notes: Source of data: URS 2001. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with “U” and “UJ” qualifiers were considered non-detects (ND); samples with “J” qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for common use areas (CUAs): CUA9 = CdA Beach at City Park; CUA16 = Higgan’s Point; CUA18 = Harrison Beach.

Table C30 – Summary of Surface Sediment Sampling Data from Locations in and along the Spokane River (Excludes Common Use Areas)

Analyte	Number of Valid Samples	Number of Detects	Range of Concs. (mg/kg)	Location (Date) of Highest Concentration	Average Conc. (mg/kg)	Standard Deviation (mg/kg)	SV (mg/kg)	Type of SV	Number (and Percent) of Samples > SV
Aluminum	21	21	52,000–87,000	LOC1 (2/17/99)	67,200	7,990	4,000	EMEG-ip	21 (100.0%)
Antimony	23	23	4.2–21	LOC1 (2/17/99)	7.8	4.0	20	RMEG-c	1 (4.3%)
Arsenic	23	23	16–70	LOC2 (2/17/99)	34	14	6	BKGD	23 (100.0%)
Cadmium	22	22	7.3–28	LOC1 (2/17/99)	17	6.6	10	EMEG-cc	19 (86.4%)
Cobalt	22	22	11–30	LOC1 (2/17/99)	17	4.2	20	EMEG-ip	3 (13.6%)
Copper	23	23	32–68	LOC1 (2/17/99)	47	10	60	EMEG-ip	3 (13.0%)
Iron	21	21	29,000–56,000	LOC2 (2/17/99)	41,100	6,600	23,000	RBC-n	21 (100.0%)
Lead	22	22	470–3,500	LOC1 (2/17/99)	950	630	400	SSL	22 (100.0%)
Manganese	21	21	1,100–4,200	LOC1 (2/17/99)	2,400	890	3,000	RMEG-c	6 (28.6%)
Vanadium	21	21	58–95	LOC2 (2/17/99)	75	8.8	6	EMEG-ip	21 (100.0%)
Zinc	22	22	1,100–6,500	LOC1 (2/17/99)	3,000	1,270	600	EMEG-ip	22 (100.0%)

Notes: Source of data: URS 2000. Analytes not found above SVs or for which no SVs are available are not shown. SVs for surface soil ingestion are used for the sediment screening.
Samples with "U" and "UJ" qualifiers were considered non-detects (ND); samples with "J" qualifiers were considered detections.
Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations. Average concentrations and standard deviations are provided for rough indicators of data variability. However, the available sampling results are not based on a single, statistically-based study.
Codes for locations (LOCs): LOC1 = unspecified location in Segment 1 of the Spokane River (Segment 1 runs from CdA Lake to Green Acres, Washington); LOC2 = Spokane River at Monroe Street Bridge in Spokane.

Table C31 – Summary of 1995–1996 IDFG Fish Tissue Sampling (reviewed in ATSDR, 1998)

Species	Sampling Location	Metal	Number of Valid Results	Range of Concentrations (ppm, wet weight)	Average Concentration (ppm, wet weight)	Standard Deviation (ppm, wet weight)
Brown Bullhead	Killarney Lake	Cadmium	42	0.005–0.069	0.0096	0.012
		Lead	42	0.0025–0.41	0.13	0.078
		Mercury	42	0.0025–0.21	0.050	0.034
	Medicine Lake	Cadmium	43	0.005–0.005	0.005	0.0
		Lead	43	0.025–0.68	0.13	0.13
		Mercury	43	0.025–0.10	0.043	0.018
	Thompson Lake	Cadmium	41	0.005–0.03	0.0070	0.0056
		Lead	41	0.025–0.69	0.15	0.15
		Mercury	40	0.025–0.18	0.049	0.036
Northern Pike	Killarney Lake	Cadmium	21	0.005–0.011	0.0053	0.0013
		Lead	21	0.025–0.09	0.032	0.019
		Mercury	21	0.025–0.22	0.12	0.048
	Medicine Lake	Cadmium	21	0.005–0.014	0.0054	0.0020
		Lead	21	0.025–0.15	0.065	0.041
		Mercury	21	0.025–0.30	0.11	0.078
	Thompson Lake	Cadmium	21	0.005–0.02	0.0070	0.0045
		Lead	21	0.025–0.12	0.031	0.021
		Mercury	21	0.025–0.48	0.12	0.12
Yellow Perch	Killarney Lake	Cadmium	43	0.005–0.169	0.039	0.035
		Lead	43	0.09–1.99	0.48	0.40
		Mercury	41	0.025–0.21	0.10	0.054
	Medicine Lake	Cadmium	41	0.05–0.115	0.042	0.032
		Lead	41	0.09–2.41	0.49	0.43
		Mercury	40	0.025–0.23	0.075	0.059
	Thompson Lake	Cadmium	39	0.005–0.119	0.016	0.021
		Lead	39	0.12–2.22	0.37	0.40
		Mercury	37	0.025–0.17	0.063	0.047

Notes: Non-detects were replaced with one-half the detection limits for purposes of calculating averages and standard deviations.
Standard deviations of zero occur for data sets with no detected concentrations.
Concentrations in the table are for fish fillets.

Table C32 - Summary of Selected Wildlife Tissue Sampling Studies

Refer to end of table for key to abbreviations and other notes

Wildlife Sampled	Number of Samples	Tissue Analyzed	Range of Measured Concentrations (wet weight basis)	Reference
American kestrel	33	Blood	Pb: ND-2.27 ppm	Henny et al., 1994
	10	Kidney	Cd: 0.03-0.39 ppm	
	10	Liver	Pb: ND-0.41 ppm; Cu 2.7-9.3 ppm; Zn: 10.4-34.2 ppm; Hg: 0.09-0.27 ppm	
American robin	10	Blood	Pb: 0.27-0.87 ppm	Blus et al., 1994
	10	Liver	Pb: 0.07-5.6 ppm	
	10	Kidney	Cd: 0.18-1.1 ppm	
Bald Eagle	4	Blood	Pb: 0.03-0.18 ppm	Audet et al., 1999a
Canada goose	4	Liver	Pb: 8.2-34.0 ppm	Blus et al., 1994
	4	Liver	Pb: 0.82-17.92 ppm	Audet et al., 1999b
	70	Blood	Pb: 0.124-1.292 ppm	Henny et al., 2000
	21	Kidney	Cd: 0.95-5.9 ppm	Blus et al., 1994
Common goldeneye	1	Blood	Pb: 12.3 ppm	Blus et al., 1994
	1	Liver	Pb: 38.0 ppm	
	1	Kidney	Cd: 0.19 ppm	
Deer mouse	6	Whole	Pb: 5.0 ppm (average)	Henny et al., 1994
	5	Whole	Pb: 18.2 ppm (average)	
Duck (coots, mallards and wood ducks)	55	Liver	Pb: ND-27.8 ppm*; Cd: ND-6.7 ppm*; Zn: 41-599 ppm*	Kreiger, 1990
	55	Kidney	Pb: ND-61.8 ppm*; Cd: ND-25.6 ppm*; Zn: 21-111 ppm*	
	55	Bone (tibia)	Pb: ND-112 ppm*; Cd: ND-0.6 ppm*; Zn: 43-173 ppm*	
	55	Breast	Pb: ND-1.6 ppm*; Cd: ND-0.1 ppm*; Zn: 9-30 ppm*	
Great horned owl	11	Blood	Pb: ND-0.26 ppm; Cd: ND-0.006 ppm	Henny et al., 1994
	6	Kidney	Cd: 0.03-0.21 ppm	
	6	Liver	Pb: 0.01-0.21 ppm; Cu: 2.7-3.5 ppm; Zn: 28.0-38.0 ppm; Hg: 0.10-0.74 ppm	
Mallard	8	Blood	Pb: 0.21-10.2 ppm	Blus et al., 1994
	8	Liver	Pb: 0.34-2.8 ppm	
	8	Kidney	Cd: 0.66-7.5 ppm	
	2	Blood	Pb: 0.188-17,390 ppm	Henny et al., 2000
	24	Liver	Pb: ND-17.89 ppm	

Table C32 - Summary of Selected Wildlife Tissue Sampling Studies

Refer to end of table for key to abbreviations and other notes

Wildlife Sampled	Number of Samples	Tissue Analyzed	Range of Measured Concentrations (wet weight basis)	Reference
	6	Liver	Pb: 0.06-11.71 ppm	Audet et al., 1999b
Mink	9	Liver	Pb: 0.39-22.0 ppm; Cu: 2.9-17.0 ppm Zn: 19.0-42.5 ppm; Hg: 0.13-1.6 ppm	Blus et al., 1987; Blus and Henny, 1990
	9	Kidney	Cd: ND-2.4 ppm	Blus et al., 1987
Muskrat	6	Liver	Pb: 0.27-0.96 ppm; Cu: 1.0-2.6 ppm; Zn: 18.4-27.4 ppm; Hg: ND-0.22 ppm	Blus et al., 1987; Blus and Henny, 1990
	6	Kidney	Cd: ND-1.13 ppm	Blus et al., 1987
	4	Liver	Pb: 0.11-5.63 ppm	Audet et al., 1999b
Northern harrier	41	Blood	Pb: ND-0.675 ppm	Henny et al., 1991
	8	Liver	Cd: 0.04-0.54 ppm	
	8	Kidney	Pb: ND-0.21 ppm; Cu: 6.1-14.0 ppm Zn: 23.0-26.0 ppm; Hg: 0.03-0.06 ppm	
Osprey	74	Blood	Pb: ND-0.82 ppm	Henny et al., 1994
	76	Blood	Pb: ND-0.34 ppm	
Red-tailed hawk	2	Blood	Pb: ND; Cd: ND	Henny et al., 1994
	2	Kidney	Pb: 0.09-0.57 ppm	
	2	Liver	Pb: ND; Cu: 1.6-2.5 ppm Zn: 22.0-27.0 ppm; Hg: ND-0.11 ppm	
Tree swallow	11	Blood	Pb: ND-0.75 ppm	Blus et al., 1994
	12	Liver	Pb: ND-0.40 ppm	
	12	Kidney	Pb: ND-0.20 ppm	
Tundra swan	34	Liver	Pb: ND-40 ppm	Blus et al., 1991
	20	Blood	Pb: 0.47-9.6 ppm	
	10	Kidney	Cd: 0.15-3.5 ppm	
	19	Blood	Pb: 0.5-6.2 ppm	Blus et al., 1999
	14	Liver	Pb: 9.3-34.3 ppm	
	83	Liver	Pb: 0.58-38.0 ppm	Audet et al., 1999b
Vole	4	Whole	Pb: 3.0-13.6 ppm; Cd: ND-0.22 ppm	Henny et al., 1994
	15	Whole	Pb: 2.4-19.0 ppm ;Cd: ND-0.36 ppm	
	6	Whole	Pb: 22.1 ppm (average)	
	4	Whole	Pb: 23.5 ppm (average)	
Western screech-owl	3	Blood	Pb: ND-0.71 ppm; Cd: 0.006-0.032 ppm	Henny et al., 1994
	1	Liver	Cd: 0.31 ppm	
	1	Kidney	Pb: ND; Cu: 2.8 ppm; Zn: 20.0 ppm; Hg: ND	

Table C32 - Summary of Selected Wildlife Tissue Sampling Studies

Refer to end of table for key to abbreviations and other notes

Wildlife Sampled	Number of Samples	Tissue Analyzed	Range of Measured Concentrations (wet weight basis)	Reference
Wood ducks	13	Liver	Pb: 0.3-14.4 ppm	Blus et al., 1992
	13	Kidney	Cd: 0.7-20.3 ppm	
	129	Blood	Pb: ND-8 ppm	

Notes: * For these samples, the reference does not specify whether measured concentrations are on a dry- or wet-weight basis
Cd = cadmium; Cu = copper; Hg = mercury; Pb = lead; and Zn = zinc.
The references detail relevant aspects of the sampling (e.g., the age and health of wildlife collected and whether they had lead shots). Detailed information on sampling locations often were not given

The purpose of the table is to illustrate that a wide range of species in the CdA Basin accumulate metals in their tissues; many of the species listed in the table, however, are not hunted or consumed. Further, some samples were taken from animals that exhibited signs of lead poisoning, and people likely would not consume these animals. The table does not provide an exhaustive list of the wildlife tissue sampling that has been conducted to date.

Table C33 – Summary of EPA's 1998 Garden Plant Sampling Data

Location	Plant Type	Number of Samples	Wet Weight Concentration for Washed Plants		
			Arsenic	Cadmium	Lead
Kingston	Carrot	2	0.01, 0.01	0.11, 0.19	0.08, 0.23
	Cauliflower	1	ND	0.05	0.01
	Lettuce	1	0.01	0.22	0.09
Moon Creek drainage basin	Carrot	1	0.03	0.16	0.3
	Radish	1	0.11	0.10	0.71
	Spearmint	1	0.07	0.04	0.80
Mullan	Rhubarb	1	ND	0.03	0.54
Osburn	Basil	1	0.03	0.19	0.88
	Cabbage	1	0.02	0.38	0.11
	Carrot	5	ND, ND, ND, 0.02, 0.02	0.02, 0.09, 0.21, 0.23, 0.23	0.04, 0.09, 0.24, 0.59, 1.42
	Cauliflower	1	ND	0.04	0.06
	Corn	1	0.03	0.07	0.03
	Lettuce	3	0.01, 0.05, 0.05	0.21, 0.60, 1.85	1.05, 1.39, 1.53
	Onion	1	ND	0.09	0.07
	Potato	4	ND, ND, 0.02, 0.03	0.09, 0.10, 0.13, 0.17	0.13, 0.13, 0.22, 0.37
Silverton	Cabbage	1	0.01	0.05	0.04
	Carrot	2	ND, 0.02	0.07, 0.47	0.08, 3.71
Woodland Park	Beet	1	ND	0.09	0.30
	Carrot	1	ND	0.15	0.45
	Kohlrabi	1	0.02	0.32	0.47
	Lettuce	2	ND, ND	0.12, 0.76	0.69, 1.21
	Radish	1	ND	0.02	0.08
	Rhubarb	1	ND	0.12	0.54

Notes Source of data: URS 2000
Samples were collected from residential Gardens
Prior to laboratory analysis, all samples were thoroughly washed to remove soil adhering to them. None of the samples were peeled. Portions of the plants that are most commonly consumed were analyzed

Table C34 – Summary of IDHW's 1976 Garden Survey

Sampling Location	Plant Type	Average Concentrations (ppm on a dry weight basis)			
		Unwashed Samples		Washed Samples	
		Cadmium	Lead	Cadmium	Lead
Cataldo	Lettuce	5	17	3	6
	Beets	9	2	2	6
	Carrots	NA	NA	2	6
Kingston	Lettuce	6	41	6	16
	Beets	2	11	2	7
	Carrots	NA	NA	2	6
Osburn	Lettuce	18	305	6	24
	Beets	6	23	3	13
	Carrots	NA	NA	5	6
Wallace	Lettuce	NA	47	NA	28
	Beets	NA	150	NA	16
	Carrots	NA	NA	NA	6

Notes: Source of data: IDHW 1976
The number of samples collected was not specified.
NA = not available. Data on unwashed carrots and cadmium levels in all vegetables collected in Wallace are not included in the reference document and are therefore not available. It is not clear why these data are not reported.

Table C35 – Ambient Air Monitoring Stations in Shoshone County with Data Submitted to EPA's AIRS Database

AIRS Site Code	Address of Monitoring Station (as listed in the AIRS database)	City	Duration of Monitoring	Types of Monitoring Data Available
Monitoring Stations Located East of the Bunker Hill Superfund Site				
160790018	Mullan	Mullan	1974–1976	TSP, metals
160790016	Wallace Post Office	Wallace	1974–1980	TSP, metals, SO_2
160790029	Osburn Radio Station (120 Osburn St.)	Osburn	1991–1999	PM_{10}
160790020	Osburn Radio Station	Osburn	1974–1985	TSP, metals, SO_2
Monitoring Stations Located West of the Bunker Hill Superfund Site				
160790015	Idaho Department of Lands	Kingston	1978–1980	TSP, metals
160790019	Cataldo	Cataldo	1974–1979	TSP, metals, SO_2
Monitoring Stations Located Inside the Bunker Hill Superfund Site				
160790010	108 W. Riverside Avenue	Kellogg	1974–1975	TSP, metals
160790004	City Hall, 14 W. Market Street	Kellogg	1970–1980	TSP, metals, sulfate
160790006	Medical Clinic, 204 Oregon	Kellogg	1971–1999	TSP, metals
160790903	3rd and Gold Street	Kellogg	1973–1974	SO_2
160790008	Kellogg Junior High School	Kellogg	1974–1975	TSP, metals
160790904	Kellogg Junior High School	Kellogg	1973–1974	SO_2
160790009	Ross Oil Co., 1731 McKinley Avenue	Kellogg	1974–1975	TSP, metals
160790007	Smelter Heights	Kellogg	1974–1975	TSP, metals
160790902	Smelter Heights	Kellogg	1973–1974	SO_2
160790901	Silverking School	Kellogg	1973–1974	SO_2
160790021	Silver King School	Smelterville	1974–1987	TSP, metals
160790022	Residence, 108 A Street	Smelterville	1974–1975	TSP, metals
160790027	Corner of Old US Highway 10 and D St.	Smelterville	1978–1980	TSP, metals
160790024	Residence, 710 Wash Street	Smelterville	1974–1975	TSP, metals
160790004	City Hall, Main Street	Smelterville	1971–1978	TSP, metals
160790025	Shoshone County Airport	Smelterville	1974–1975	TSP, metals
160790023	Residence, Box 412	Page	1974–1975	TSP, metals
160790017	Pinehurst School	Pinehurst	1974–1999	PM_{10}, TSP, metals, SO_2

Notes: Addresses presented in this table are copied directly from AIRS.
Stations that collected only dust fall measurements are not included in this data summary.
TSP = total suspended particulate; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide.
At stations where concentrations of metals were measured, the analytes reported to AIRS were typically cadmium, lead, and zinc.
The duration of monitoring for each station indicates the first and last year for which any monitoring data are available for a given station. Not every monitoring station operated continuously during the ranges of years shown. Some stations sampled air for different pollutants during different years within the listed ranges.

Table C36 – Summary of TSP Measurements Reported to AIRS for Monitoring Stations in Shoshone County

Address of Monitoring Station	City	Annual Data			24-Hour Data	
		Highest Average Conc. (μg/m^3)	Standard Deviation (μg/m^3)	Year Highest Average Occurred	Highest Level Measured (μg/m^3)	Year Highest Level Occurred
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Mullan	Mullan	87.2	68.8	1975	510.1	1974
Wallace Post Office	Wallace	67.6	37.7	1975	6,160	1980***
Osburn Radio Station	Osburn	93.0	65.0	1981	6,644	1980***
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Idaho Dept. of Lands	Kingston	59.2	46.1	1979	7,179	1980***
Cataldo	Cataldo	92.9	67.2	1979	576.1	1974
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
108 W. Riverside Ave.	Kellogg	NA	NA	NA	241.0	1975
City Hall (W. Market Str.)	Kellogg	129.2	70.7	1973	5,084	1980***
Medical Clinic	Kellogg	151.0	90.2	1973	939.7	1980***
Kellogg Jr. High School	Kellogg	NA	NA	NA	276.0	1975
Ross Oil Company	Kellogg	NA	NA	NA	485.0	1974
Smelter Heights	Kellogg	NA	NA	NA	424.0	1975
Silver King School	Smelterville	125.4	83.5	1976	5,072	1980***
Residence on A Street	Smelterville	NA	NA	NA	341.0	1975
Old US Highway 10	Smelterville	114.8	65.3	1979	6,976	1980***
Residence on Wash Street	Smelterville	NA	NA	NA	287.0	1974
City Hall, Main Street	Smelterville	173.3	162.3	1973	1,075	1972
Shoshone County Airport	Smelterville	NA	NA	NA	245.0	1974
Residence, Box 412	Page	NA	NA	NA	252.0	1975
Pinehurst School	Pinehurst	117.0	101.9	1982	7,148	1980***

Notes: Screening values (EPA former NAAQS): Annual average = 75 μg/m^3; maximum 24-hour average = 260 μg/m^3.
The highest annual average concentrations were computed only for monitoring stations that had at least one calendar year in which more than 9 months of valid data were reported. Stations that do not have enough data to meet this criterion have an annual average value listed as “NA” (for not applicable).
The highest 24-hour average concentration is the highest level reported for each station, regardless of the number of samples reported in a year.
*** The many extreme peak concentrations that occurred during 1980 are believed to be caused primarily by ash from Mt. St. Helen’s—a volcano in southwest Washington that erupted May 18, 1980. Because of these peaks, the annual average concentrations for 1980 were heavily biased. Annual average data for 1980 were not considered when preparing this table, because the data for that year largely reflect the influence of a source other than the Bunker Hill facilities.

Table C37 – Annual Average TSP Concentrations Reported to AIRS by Monitoring Stations in the CdA Basin: 1975–1979

Monitoring Station	City	Annual Average Concentration (± Standard Deviation), μg/m^3				
		1975	1976	1977	1978	1979
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Mullan	Mullan	87.3 (± 68.8)	NA	NA	NA	NA
Wallace Post Office	Wallace	67.6 (± 37.7)	61.9 (± 41.1)	59.9 (± 36.9)	51.9 (± 28.8)	63.3 (± 40.4)
Osburn Radio Station	Osburn	72.4 (± 39.0)	78.6 (± 51.1)	68.1 (± 36.2)	66.1 (± 44.8)	83.3 (± 49.4)
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Idaho Department of Lands	Kingston	NA	NA	NA	38.1 (± 41.0)	59.2 (± 46.1)
Cataldo	Cataldo	67.6 (± 52.7)	71.1 (± 45.5)	58.4 (± 28.8)	57.2 (± 54.2)	92.9 (± 67.2)
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
City Hall, 14 W. Market Street	Kellogg	89.4 (± 44.9)	101.2 (± 54.6)	86.1 (± 44.4)	81.9 (± 66.0)	89.8 (± 42.9)
Medical Clinic, 204 Oregon	Kellogg	92.6 (± 47.7)	106.1 (± 75.7)	88.1 (± 44.8)	83.9 (± 59.4)	95.6 (± 56.2)
Silver King School	Smelterville	113.4 (± 68.8)	125.4 (± 83.5)	99.6 (± 56.5)	100.3 (±140.8)	101.3 (± 64.3)
Corner of Old US Highway 10 and D Street	Smelterville	NA	NA	NA	NA	114.8 (± 65.3)
City Hall, Main Street	Smelterville	102.5 (± 51.1)	121.3 (± 65.0)	100.3 (± 46.8)	86.3 (± 61.9)	NA
Pinehurst School	Pinehurst	92.8 (± 48.0)	95.8 (± 48.5)	94.3 (± 53.8)	77.6 (± 45.2)	92.4 (± 48.4)

Notes: Screening value (EPA former NAAQS): annual average = 75 μg/m^3.
The table presents data for 1975–1979 because this is the longest time frame when monitoring stations outside of the Bunker Hill site collected data while the smelting facilities operated.
Data for 1980 were not included in this tabulation due to the influence in that year from the Mt. St. Helens volcano.
Annual average concentrations were calculated for monitoring stations that had at least one calendar year in which more than 9 months of valid data were reported. Stations that do not have enough data to meet this criterion have an annual average value listed as "NA" (for not applicable).

Table C38 – 24-Hour Average TSP Concentrations Reported to AIRS by Monitoring Stations in the CdA Basin: 1975–1979

Monitoring Station	City	Number of Samples > SV / Total Number of Samples (Percent of Samples > SV)				
		1975	1976	1977	1978	1979
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Mullan	Mullan	4/117 (3%)	NA	NA	NA	NA
Wallace Post Office	Wallace	0/81 (0%)	1/109 (1%)	0/91 (0%)	0/106 (0%)	0/99 (0%)
Osburn Radio Station	Osburn	0/129 (0%)	1/108 (1%)	0/95 (0%)	1/107 (1%)	2/109 (2%)
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Idaho Department of Lands	Kingston	NA	NA	NA	1/106 (1%)	0/100 (0%)
Cataldo	Cataldo	1/120 (1%)	1/108 (1%)	0/93 (0%)	1/105 (1%)	3/105 (3%)
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
City Hall, 14 W. Market Street	Kellogg	0/121 (0%)	1/112 (1%)	0/88 (0%)	1/93 (1%)	0/108 (0%)
Medical Clinic, 204 Oregon	Kellogg	0/131 (0%)	2/107 (2%)	0/91 (0%)	2/103 (2%)	2/107 (2%)
Silver King School	Smelterville	5/132 (4%)	5/110 (5%)	1/95 (1%)	3/106 (3%)	3/106 (3%)
Corner of Old US Highway 10 and D Street	Smelterville	NA	NA	NA	NA	4/109 (4%)
City Hall, Main Street	Smelterville	3/133 (2%)	4/108 (4%)	0/91 (0%)	1/80 (1%)	NA
Pinehurst School	Pinehurst	0/127 (0%)	0/105 (0%)	2/86 (2%)	0/102 (0%)	0/106 (0%)

Notes: Screening value (EPA former NAAQS): 24-hour average = 260 $\mu g/m^3$.
The table presents data for 1975–1979 because this is the longest time frame when monitoring stations outside of the Bunker Hill site collected data while the smelting facilities operated.
Data for 1980 were not included in this tabulation due to the influence in that year from the Mt. St. Helens volcano.
Statistics are compiled for monitoring stations that had at least one calendar year in which more than 9 months of valid data were reported. Stations that do not have enough data to meet this criterion have an entry of "NA" (for not applicable) for the years with only partial sampling.

Table C39 – Summary of PM_{10} Concentrations in Shoshone County Reported to AIRS, by Year

Year	Data Collected East of the Box at the Osburn Radio Station Monitor			Data Collected Inside the Box at the Pinehurst School Monitor		
	Annual Average Conc. (μg/m^3)	Standard Deviation (μg/m^3)	Highest 24-Hour Level (μg/m^3)	Annual Average Conc. (μg/m^3)	Standard Deviation (μg/m^3)	Highest 24-Hour Level (μg/m^3)
1986	NA	NA	NA	75.1***	67.8	372***
1987	NA	NA	NA	67.2***	53.3	189***
1988	NA	NA	NA	56.3***	36.0	183***
1989	NA	NA	NA	45.5	35.8	306***
1990	NA	NA	NA	37.9	24.1	142
1991	NA	NA	62	56.5***	48.4	439***
1992	24.9	19.6	133	39.3	22.1	113
1993	35.6	22.5	135	51.2***	28.0	149
1994	31.0	19.8	144	37.9	22.1	112
1995	23.1	14.9	75	35.3	24.4	115
1996	22.8	14.5	93	30.0	16.8	107
1997	26.3	15.8	97	31.4	19.9	110
1998	21.3	16.3	107	26.8	20.8	177***
1999	NA	NA	47	NA	NA	50

Notes: Screening values (EPA's current NAAQS): Annual average = 50 μg/m^3; maximum 24-hour average = 150 μg/m^3.
Annual average concentrations were computed only for calendar years in which more than 9 months of valid data were reported. When this did not occur, an annual average value of "NA" (for not applicable) was entered.
The highest 24-hour average concentration is the highest level reported for each station, regardless of the number of samples reported in a year.
*** These concentrations exceed their corresponding screening values.

Table C40 – Annual Average Cadmium Concentrations in TSP Reported to AIRS by Monitoring Stations in the CdA Basin: 1975–1979

Monitoring Station	City	Annual Average Cadmium Concentration in TSP (± Standard Deviation), µg/m^3				
		1975	1976	1977	1978	1979
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Mullan	Mullan	0.01 (± 0.01)	NA	NA	NA	NA
Wallace Post Office	Wallace	0.03 (± 0.05)	0.05 (± 0.14)	0.07 (± 0.08)	0.06 (± 0.07)	0.07 (± 0.11)
Osburn Radio Station	Osburn	0.07 (± 0.10)	0.08 (± 0.09)	0.11 (± 0.15)	0.10 (± 0.21)	0.12 (± 0.21)
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Idaho Department of Lands	Kingston	NA	NA	NA	0.11 (± 0.23)	0.07 (± 0.09)
Cataldo	Cataldo	0.04 (± 0.04)	0.05 (± 0.06)	0.06 (± 0.10)	0.07 (± 0.12)	0.06 (± 0.08)
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
City Hall, 14 W. Market Street	Kellogg	0.15 (± 0.19)	0.25 (± 0.25)	0.26 (± 0.31)	0.31 (± 0.51)	0.31 (± 0.37)
Medical Clinic, 204 Oregon	Kellogg	0.17 (± 0.31)	0.26 (± 0.28)	0.25 (± 0.29)	0.29 (± 0.45)	0.31 (± 0.32)
Silver King School	Smelterville	0.32 (± 0.43)	0.46 (± 0.46)	0.42 (± 0.48)	0.63 (± 1.22)	0.56 (± 0.80)
Corner of Old US Highway 10 and D Street	Smelterville	NA	NA	NA	NA	0.43 (± 0.47)
City Hall, Main Street	Smelterville	0.19 (± 0.29)	0.31 (± 0.30)	0.27 (± 0.26)	0.20 (± 0.20)	NA
Pinehurst School	Pinehurst	0.08 (± 0.09)	0.13 (± 0.17)	0.12 (± 0.11)	0.16 (± 0.29)	0.19 (± 0.27)

Notes: Screening value (CREG) = 0.0006 µg/m^3.
The table presents data for 1975–1979 because this is the longest time frame when monitoring stations outside of the Bunker Hill site collected data while the smelting facilities operated.
Data for 1980 were not included in this tabulation due to the influence in that year from the Mt. St. Helens volcano.
Annual average concentrations were calculated for monitoring stations that had at least one calendar year in which more than 9 months of valid data were reported. Stations that do not have enough data to meet this criterion have an annual average value listed as "NA" (for not applicable).

Table C41 – Annual Average Lead Concentrations in TSP Reported to AIRS by Monitoring Stations in the CdA Basin: 1975–1979

Monitoring Station	City	Annual Average Cadmium Concentration in TSP (± Standard Deviation), µg/m^3				
		1975	1976	1977	1978	1979
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Mullan	Mullan	0.52 (± 0.33)	NA	NA	NA	NA
Wallace Post Office	Wallace	0.99 (± 1.16)	0.77 (± 0.53)	1.40 (± 1.80)	0.81 (± 0.91)	0.91 (± 1.52)
Osburn Radio Station	Osburn	1.86 (± 2.71)	1.57 (± 1.62)	2.47 (± 3.43)	1.45 (± 1.80)	1.77 (± 2.93)
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Idaho Department of Lands	Kingston	NA	NA	NA	0.87 (± 1.64)	0.97 (± 0.93)
Cataldo	Cataldo	0.98 (± 1.08)	1.00 (± 1.02)	1.08 (± 1.41)	0.76 (± 1.19)	0.81 (± 0.68)
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
City Hall, 14 W. Market Street	Kellogg	7.57 (± 9.24)	7.13 (± 5.61)	7.04 (± 6.06)	6.16 (± 7.77)	5.86 (± 5.60)
Medical Clinic, 204 Oregon	Kellogg	7.09 (± 7.48)	7.46 (± 5.32)	6.77 (± 5.28)	5.44 (± 5.71)	5.80 (± 4.54)
Silver King School	Smelterville	15.73 (±12.43)	14.78 (±10.39)	13.97 (±10.84)	10.77 (±15.15)	10.79 (±10.20)
Corner of Old US Highway 10 and D Street	Smelterville	NA	NA	NA	NA	8.14 (± 7.09)
City Hall, Main Street	Smelterville	8.88 (± 7.91)	9.76 (± 5.95)	9.18 (± 6.80)	5.26 (± 4.78)	NA
Pinehurst School	Pinehurst	3.09 (± 2.93)	3.29 (± 3.09)	3.46 (± 3.10)	2.58 (± 3.36)	3.03 (± 3.00)

Notes: Screening value (EPA NAAQS, quarterly average) = 1.5 µg/m^3.
The table presents data for 1975–1979 because this is the longest time frame when monitoring stations outside of the Bunker Hill site collected data while the smelting facilities operated. Data for 1980 were not included in this tabulation due to the influence in that year from the Mt. St. Helens volcano.
Annual average concentrations were calculated for monitoring stations that had at least one calendar year in which more than 9 months of valid data were reported. Stations that do not have enough data to meet this criterion have an annual average value listed as "NA" (for not applicable).

Table C42a – Summary of Sulfur Dioxide Data Reported to AIRS: Intensive Monitoring Study from April 1973 to May 1974

Monitoring Station	City	24-Hour Average Data			Annual Average Data	
		Number of Valid 24-Hour Average Sample Results Reported to AIRS	Number of Valid 24-Hour Average Sample Results Greater than SV	Highest 24-Hour Average Concentration (μg/m^3)	Program-Average Concentration (μg/m^3)	Standard Deviation (μg/m^3)
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
3rd and Gold Street	Kellogg	398	87	1,537	268	227
Kellogg Junior High School	Kellogg	399	24	1,648	152	169
Silver King School	Kellogg	359	86	2,273	267	242
Smelter Heights	Kellogg	366	141	2,234	379	293

Notes: Screening values: EPA NAAQS, 24-hour average = 365 μg/m^3; EPA NAAQS, annual average = 80 μg/m^3.
No monitoring data were collected at locations outside of the Bunker Hill Superfund site during this study.
The program-average concentrations, for this study, are average concentrations for the time frame April 1973–May 1974, which is approximately 1 year.

Table C42b – Summary of Sulfur Dioxide Data Reported to AIRS: Intensive Monitoring Study from January 1976 to December 1977

Monitoring Station	City	24-Hour Average Data			Annual Average Data	
		Number of Valid 24-Hour Average Sample Results Reported to AIRS	Number of Valid 24-Hour Average Sample Results Greater than SV	Highest 24-Hour Average Concentration (μg/m^3)	Highest Annual Average Level (μg/m^3)	Standard Deviation (μg/m^3)
Monitoring Stations Located East of the Bunker Hill Superfund Site						
Osburn Radio Station	Osburn	149	1	407	48.7 (in 1976)	50.6
Wallace Post Office	Wallace	148	0	228	26.7 (in 1977)	48.7
Monitoring Stations Located West of the Bunker Hill Superfund Site						
Cataldo	Cataldo	150	0	274	25.1 (in 1976)	38.7
Monitoring Stations Located Inside the Bunker Hill Superfund Site						
Pinehurst School	Pinehurst	144	1	441	64.5 (in 1976)	72.2

Notes: Screening values: EPA NAAQS, 24-hour average = 365 μg/m^3; EPA NAAQS, annual average = 80 μg/m^3.
For this study, each monitoring station had two annual average concentrations, one for 1976 and the other for 1977. For each station, the higher of the two annual average concentrations is shown.

Table C43 - Table of Environmental Exposure Pathways at the Bunker Hill Mining and Metallurgical Complex Superfund Facility Operable Unit 3 (Coeur d'Alene River Basin site): Completed Environmental Exposure Pathways

Source	Environmental Medium	Pathway Status	Point of Exposure	Route of Exposure	Exposed Population	Contaminant	Number Exposed
Bunker Hill facility and other sources	Ambient Air	Past	Indoor and outdoor air in areas near the "Box"	Inhalation	Residents and visitors in the area of the "Box"	Total suspended particulates including lead and cadmium	unknown
Past mining activities	Groundwater used as a potable source	Past	Residential and school wells in Osburn Flats	Ingestion; direct contact	Residents of Osburn Flats	Lead, cadmium, and zinc	unknown
Past mining activities	Surface water/groundwater used as potable source	Past	Tap at Killarney Lake boat launch and other locations in the CdA Basin	Ingestion; direct contact	Visitors who use the tap at Killarney Lake and others who	Arsenic and zinc	unknown
Past mining activities	Groundwater used as potable source	Past, present, future	Common use areas and residential locations that use private wells	Ingestion, direct contact	People in the Basin who consume water drawn from alluvial deposits without first treating it	Metals	unknown
Past mining activities	Residential Soil	Past, present, future	Various residential locations throughout the Basin	Incidental ingestion	People with contaminated yard soils that are not adequately covered to prevent erosion	Metals	unknown
Past mining activities	Household dust	Past, present, future	Various residential locations throughout the Basin	Incidental ingestion	People in households where contaminated are tracked in	Metals	unknown
Past mining activities	Neighborhood soils	Past, present, future	Vicinity of old mining operations, wastepiles, waste dumps, tailings piles, recreational areas	Ingestion	Persons who incidentally or deliberately ingest soils outside of the household	Metals	unknown
Lead-based paint	Household dust	Past, present, future	Homes constructed prior to 1978 with peeling paint	Ingestion	Persons who incidentally or deliberately ingest paint chips	Lead	unknown

Table C43 - Table of Environmental Exposure Pathways at the Bunker Hill Mining and Metallurgical Complex Superfund Facility Operable Unit 3 (Coeur d'Alene River Basin site): Completed Environmental Exposure Pathways

Source	Environmental Medium	Pathway Status	Point of Exposure	Route of Exposure	Exposed Population	Contaminant	Number Exposed
Past mining activities	Surface soils and sediments	Past, present, future	Trail of the Coeur d'Alenes (TCdA)	Incidental ingestion, direct contact	People who maintain the TCdA	Lead and other metals	unknown
Past mining activities	Surface water and sediments	Past, present, future	Common use areas (CUAs)	Incidental ingestion and direct contact	People who recreate in CUAs that are known to have contaminated surface water and sediments	Lead and other metals	unknown
Past mining activities	Biota	Past, present, future	Some locally caught fish, waterfowl, and locally harvested water potatoes and other biota	Ingestion	People in the community who consume locally caught and harvested biota	Lead and other metals	unknown

Table C44 - Table of Environmental Exposure Pathways at the Bunker Hill Mining and Metallurgical Complex Superfund Facility Operable Unit 3 (Coeur d'Alene River Basin site): Potential Environmental Exposure Pathways

Source	Environmental Medium	Pathway Status	Point of Exposure	Route of Exposure	Exposed Population	Contaminant	Number Exposed
Past mining activities	Surface waters and sediments in drainage ditches, streams, adits, etc.	Past, present, future	Streams, adits, drainage ditches, and other non-recreational surface water bodies	Ingestion, direct contact	Miners, recreational users, residents	Lead and other metals	unknown
Past mining activities	Surface waters in the vicinity of CUAs	Past, present, future	Various locations, including beaches, campgrounds, and ponds	Ingestion	People who draw drinking water from surface water bodies in the vicinity of CUAs	Lead and other metals	unknown
Past mining activities	Water Potatoes harvested in the Basin	Present	varied	Ingestion	Tribal members and others who harvest water potatoes	Metals	None known
Past mining activities	Subsurface soils and sediments	Present, future	varied	Direct contact	Remedial Workers	Metals	None known

Table C45 - Theoretically Possible Multiple Pathway Exposure Scenarios

	Maximally Exposed Resident Child	Maximally Exposed Resident Adult	Average Exposed Resident Child	Average Exposed Resident Adult	Maximally Exposed Resident Child living on non-contaminated property	Maximally Exposed Resident Adult living on non-contaminated property	Average Exposed Resident Child living on non-contaminated property	Average Exposed Resident Adult living on non-contaminated property	Maximally Exposed Non-Resident Child	Average Exposed Non-Resident Child
Maximum Contaminated Residence Soil	X	X								
Average Contaminated Residence Soil			X	X						
Maximum Contaminated Household Dust	X									
Average Contaminated Household Dust		X	X	X						
Maximum Contaminated Garden Soil	X	X								
Average Contaminated Garden Soil			X	X						
Maximum Contaminated CUA Soil	X	X			X	X			X	
Average Contaminated CUA Soil			X	X			X	X		X
Maximum Contaminated CUA Sediment	X	X			X	X			X	

Table C45 - Theoretically Possible Multiple Pathway Exposure Scenarios

	Maximally Exposed Resident Child	Maximally Exposed Resident Adult	Average Exposed Resident Child	Average Exposed Resident Adult	Maximally Exposed Resident Child living on non-contaminated property	Maximally Exposed Resident Adult living on non-contaminated property	Average Exposed Resident Child living on non-contaminated property	Average Exposed Resident Adult living on non-contaminated property	Maximally Exposed Non-Resident Child	Average Exposed Non-Resident Child
Average Contaminated CUA Sediment			X	X			X	X		X
Maximum Contaminated Vegetables	X	X								
Average Contaminated Vegetables			X	X						
Maximum Contaminated Area off UPRR	X	X			X	X			X	
Average Contaminated Area off UPRR			X	X			X	X		X
Maximum Contaminated Mining/Tailings Piles	X				X	X				
Average Contaminated Mining/Tailings Piles			X				X	X		

The most important pathways of exposure within the Basin are exposures of children to residential soil and household dusts.
Persons residing in homes with high concentrations of lead in soil and household dusts need to take precautions to reduce their exposure to additional sources of lead including limiting time spent at contaminated CUAs.
Those exposures related to aquatic biota harvested from Lake Coeur d'Alene will be addressed in a separate document once data become available.

Appendix D–Health Guidelines, Exposure Dose Estimation, Risk and Results of Exposure Dose Estimate Comparison to Health Guidelines

D.1. Health Guidelines

Health guidelines provide a basis for comparing estimated exposures with concentrations of contaminants in different environmental media (air, soil and water) to which people might be exposed.

Non-Cancer Health Effects

ATSDR has developed a **Minimal Risk Level (MRLs)** for contaminants of concern found at hazardous waste sites. The MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (non-carcinogenic) over a specified duration of exposure. MRLs are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specified duration within a given route of exposure. MRLs are based only on noncancerous health effects, and do not consider carcinogenic effects: therefore, an MRL does not imply anything about the presence, absence, or level of cancer risk.. MRLs are developed for different routes of exposure, like inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15–364 days), and chronic (365 days or greater). Oral MRLs are expressed in units of milligrams of contaminant per kilogram of body weight per day (mg/kg/day). Because ATSDR has no methodology to determine amounts of chemicals absorbed through the skin, the Agency has not developed MRLs for dermal exposure. If an ATSDR MRL is not available as a health value, then EPA's Reference Dose (RfD) is used. The RfD is an estimate of daily human exposure to a contaminant for a lifetime below which (non-cancer) health effects are unlikely to occur (ATSDR 1992a).

Cancer Health Effects

The EPA classifies chemicals as Class A, Class B, Class C, Class D, or Class E. This classification defines a specific chemical's ability to cause cancer in humans and animals. According to EPA, Class A chemicals are known human carcinogens, and Class B chemicals are probable human carcinogens. Class B is further subdivided into two groups: Group B1 consists of chemicals for which there is limited evidence of carcinogenicity from epidemiologic studies in humans; and Group B2 consists of chemicals for which there is sufficient evidence of carcinogenicity in animals, but inadequate evidence or no data available from epidemiologic studies in humans. Group C chemicals are possible human carcinogens. Group D chemicals are not classifiable as to human carcinogenicity and Group E chemicals are those for which there is evidence that they are not carcinogenic to humans. For carcinogenic substances, EPA has established the Cancer Slope Factor (CSF) as a guideline. The CSF is used to determine the number of excess cancers resulting from exposure to a contaminant. The National Toxicology Program in its Annual Report on Carcinogens classifies a chemical as a "known human carcinogen" based on sufficient human data. Its classification of a chemical as being "reasonably anticipated to be a carcinogen (RAC) is based on limited human or sufficient animal data. ATSDR considers the above physical and biological characteristics when developing health guidelines.

D.2. Description of Select Screening Values and Health Guidelines

Cancer Effect Level (CEL) is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiological studies. CELs are always considered serious effects.

Cancer Risk Evaluation Guides (CREGs) are estimated concentrations of contaminants that are expected to cause no more than one excess cancer case for every million (1×10^{-6}) persons who are continuously exposed to the concentration for an entire lifetime. These concentrations are calculated from EPA's cancer slope factors, which indicate the relative potency of carcinogenic chemicals. Only chemicals that are known or suspected of being carcinogenic have CREG screening values. It should be noted that exposures equivalent to CREGs are not actually expected to cause one excess cancer in a million persons exposed over a lifetime. Nor does it mean that every person in the exposed population of one million has a 1-in-a-million chance of developing cancer from the specific exposure. Although commonly interpreted in precisely these ways, the CREGs reflect only a rough estimate of population risks, which should not be applied directly to any individual.

Environmental Media Evaluation Guide (EMEGs) are estimates of chemical concentrations that are not likely to cause an appreciable risk of deleterious, noncancerous health effects for fixed durations of exposure. These concentrations factor in estimates of receptor body weight and rates of ingestion. EMEGs might reflect several different types of exposure: acute (<14 days), intermediate (15-364 days), and chronic (>365 days). These concentrations are ultimately based on data published in ATSDR Toxicological Profiles for specific chemicals.

Lowest-Observed-Adverse-Effect-Level (LOAELs) is defined as the lowest dose of chemical in a study, or group of studies, that produces statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.

National Ambient Air Quality Standards (NAAQS) are developed by EPA to protect people and the environment from unhealthy and undesirable levels of air pollution. As of the writing of this report, EPA has promulgated NAAQS for seven pollutants (known as "criteria pollutants"). These standards have been developed specifically to protect the health and welfare of humans. To be conservative, these standards were designed to be protective of exposed persons, including most "sensitive" populations (e.g., persons with asthma).

Risk-Based Concentrations (RBCs) are derived by Region 3 of the U.S. Environmental Protection Agency (EPA) and represent concentrations of contaminants in tap water, ambient air, fish or soil (industrial or residential) that are considered unlikely to cause adverse health effects. They are derived using conservative exposure assumptions and

EPA's Reference Doses, Reference Concentrations, or slope factors. RBCs are based either on cancer or non-cancer effects.

D.3. Exposure Dose Estimation

To link the site's human exposure potential with health effects that may occur under site-specific conditions, ATSDR estimates human exposure to the site contaminant from ingestion and/or inhalation of different environmental media (ATSDR 1992a). The following relationship is used to determine the estimated exposure to the site contaminant:

$$ED = ((C \times IR \times EF) \times 1E^{-06}) / BW$$

ED = exposure dose (mg/kg/day)
C = contaminant concentration
IR = intake rate
EF = exposure factor
BW = body weight

For screening purposes it was assumed that body weights for adults, young children, and toddlers are 70 kilograms (kg), 16 kg, and 10 kg, respectively. The maximum contaminant concentration detected at a site for a specific medium is used to determine the estimated exposure. Use of the maximum concentration will result in the most protective evaluation for human health. The recreational ingestion rates for soil were assumed to be 100 mg/day for adults and children. A small child (aged 1 to 3 years old) may on occasion ingest 5,000 mg/day (one teaspoon per day) of contaminated soil. Exposure doses for children exhibiting pica behavior were reviewed in detail for residential exposures but not extensively for CUAs (CUAs) because it is very unlikely that a child displaying pica behavior would be given the opportunity to ingest large quantities of soil at CUAs. It was assumed that people would ingest no more than 0.09 litres of water while swimming and conducting other recreational activities. It was assumed also that people would consume no more than one litre per day of water from taps at area recreational sites. The ingestion rate of water from supplies used as potable water sources was assumed to be one litre per day for children and two litres per day for adults. It was assumed that recreational fishers and their families would eat approximately eight ounces of fish per day for no more than three days per week. It was assumed that subsistence fisher (non-tribal) would consume no more than 12 ounces of fish per day for no more than three days per week. It was assumed that tribal members would eat no more than one pound of fish per day for no more than three days per week. It was assumed that people who eat locally harvested crayfish would eat no more than 1 pound of the crayfish per day for no more than once a week. Some exposures are intermittent or irregularly timed. For those exposures, an exposure factor (EF) was calculated which averages the dose over the exposed period. It was assumed that people would not spend more than 100 days per year at area CUAs. When unknown the biological absorption from an environmental medium is assumed to be 100%.

D.4. How Risk Estimates are Made

Non-Cancer Risks

For non-carcinogenic health risks, the contaminant intake was estimated using exposure assumptions for the site conditions. This dose was then compared to a risk reference dose (estimated daily intake of a chemical that is likely to be without an appreciable risk of health effects) developed by ATSDR and EPA.

Non-carcinogenic effects, unlike carcinogenic effects are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice is to identify, usually from animal toxicology experiments, a **No-Observed-Adverse-Effect-Level (NOAEL).** The NOAEL is defined as the dose of chemical at which there were no statistically or biologically significant increases in the frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse. The NOAEL is then divided by an uncertainty factor (UF) to yield a risk reference dose. The UF is number which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the UF takes into consideration various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the incompleteness of available data. Thus, exposure doses at or below the risk reference dose are not expected to cause adverse health effects because it is selected to be much lower than dosages that do not cause adverse health effects in laboratory animals.

The measure used to describe the potential for non-cancer health effects to occur in an individual is expressed as a ratio of estimated contaminant intake to the risk reference dose. If exposure to the contaminant exceeds the risk reference dose, there is concern for potential non-cancer health effects. As a rule, the greater the ratio of the estimated contaminant intake to the risk reference dose, the greater the level of concern. A ratio equal to or less than one is generally considered an insignificant (minimal) increase in risk.

Cancer Risks

Increased cancer risks were estimated by using site-specific information on exposure levels for the contaminant of concern and interpreting them using cancer potency estimates derived for that contaminant by EPA. An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant.

There is insufficient knowledge of cancer mechanisms to decide if there exists a level of exposure to a cancer-causing agent below which there is no risk of getting cancer, namely, a threshold level. Therefore, every exposure, no matter how low, to a cancer-causing compound is assumed to be associated with some increased risk. As the dose of a carcinogen decreases, the chance of developing cancer decreases, but each exposure is accompanied by some increased risk.

There is no general consensus with the scientific or regulatory communities on what level of estimated excess cancer risk is acceptable. Some have recommended the use of the relatively conservative excess lifetime cancer risk level of one in one million because of the uncertainties in our scientific knowledge about the mechanism of cancer. Others feel that risks that are lower or higher may be acceptable, depending on scientific, economic, and social factors. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk.

D.5. Sources of Health Guideline Information

ATSDR has prepared toxicological profiles for many substances found at hazardous waste sites. Those documents present and interpret information on the substances. Health guidelines, such as ATSDR's MRL and EPA's RfD and CSF are included in the toxicological profiles. Those health guidelines are used by ATSDR health professionals in determining the potential for developing adverse non-carcinogenic health effects and/or cancer from exposure to a hazardous substance. The preparers of this public health assessment have reviewed the profiles for the contaminants of concern at the Bunker Hill/CdA River Basin site.

Table D1 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for Residential Populations with Contaminated Properties Exposed East of the Box

Contaminant	Maximally Exposed Adult	Maximally Exposed Child	Average Exposed Adult	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.03952	0.1581	0.01884	0.0754	2	MRLi
Arsenic	0.0016	0.0064	0.00003	0.0001	0.005	MRLa
Barium	0.0004	0.0017	0.00002	0.00009	0.07	RfD
Cadmium	0.0001	0.0004	0.000006	0.00003	0.0002	MRLc
Chromium	0.0002	0.0007	0.00001	0.00005	0.003	RfD
Cobalt	0.00008	0.0003	0.00001	0.00004	0.01	MRLi
Copper	0.0014	0.0057	0.00009	0.0004	0.02	MRLi
Iron	0.1772	0.7087	0.0266	0.1063	NA	NA
Lead	0.0917	0.3667	0.0016	0.0065	NA	NA
Manganese	0.0119	0.0476	0.0014	0.0055	NA	NA
Mercury	0.00002	0.00008	0.000001	0.000004	0.007	MRLa
Thallium	0.000008	0.00003	0.000001	0.000004	NA	NA
Vanadium	0.00008	0.0003	0.00002	0.0001	0.003	MRLi
Zinc	0.019	0.076	0.001	0.0042	0.3	MRLi

Notes: Highlighted doses exceed the health guideline or do not have corresponding health guidelines

Table D2 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for Residential Populations with non-Contaminated Properties Exposed East of the Box

Contaminant	Maximally Exposed Adult	Maximally Exposed Child	Average Exposed Adult	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.014	0.0561	0.0077	0.0308	2	MRLi
Antimony	0.0001	0.0005	0.000003	0.00001	0.0004	RfD
Arsenic	0.0004	0.0016	0.00001	0.00004	0.005	MRLa
Barium	0.0004	0.0017	0.00002	0.00009	0.07	RfD
Cadmium	0.00003	0.0001	0.000003	0.00001	0.0002	MRLc
Cobalt	0.00003	0.0001	0.000004	0.00002	0.01	MRLi
Copper	0.0004	0.0015	0.00003	0.0001	0.02	MRLi
Iron	0.0586	0.2344	0.0107	0.0429	NA	NA
Lead	0.0081	0.0324	0.0006	0.0025	NA	NA
Manganese	0.0035	0.0139	0.0006	0.0023	NA	NA
Mercury	0.000006	0.00003	0.0000005	0.000002	0.007	MRLa
Thallium	0.000004	0.00001	0.0000007	0.000003	NA	NA
Vanadium	0.00002	0.00008	0.00001	0.00004	0.003	MRLi
Zinc	0.0044	0.0177	0.0005	0.002	0.3	MRLi

Notes: Shaded doses exceed the corresponding health guideline or do not have health guidelines

Table D3 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for non-Residential Populations Exposed East of the Box

Contaminant	Maximally Exposed Adult	Maximally Exposed Child	Average Exposed Adult	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.001	0.004	0.0005	0.0018	2	MRLi
Antimony	0.000007	0.00003	0.0000003	0.000001	0.0004	RfD
Arsenic	0.00003	0.0001	0.0000008	0.000003	0.005	MRLa
Barium	0.0001	0.0005	0.000007	0.00003	0.07	RfD
Cadmium	0.000003	0.00001	0.0000002	0.0000007	0.0002	MRLc
Cobalt	0.000002	0.000008	0.0000003	0.000001	0.01	MRLi
Copper	0.00004	0.0002	0.000002	0.000008	0.02	MRLi
Iron	0.0045	0.0179	0.0007	0.0027	NA	NA
Lead	0.0011	0.0044	0.00004	0.0002	NA	NA
Manganese	0.0003	0.0012	0.00004	0.0001	NA	NA
Mercury	0.0000005	0.000002	0.00000003	0.0000001	0.007	MRLa
Vanadium	0.000001	0.000004	0.0000006	0.000002	0.003	MRLi
Zinc	0.0006	0.0022	0.00003	0.0001	0.3	MRLi

Notes: Shaded doses exceed the corresponding health guideline or do not have health guidelines

Table D4 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for Residential Populations with Contaminated Properties Exposed West of the Box

Contaminant	Maximally Exposed Adult	Average Exposed Adult	Maximally Exposed Child	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.0357	0.0144	0.1427	0.0576	2	MRLi
Arsenic	0.0002	0.00003	0.0008	0.0001	0.005	MRLa
Cadmium	0.00003	0.000003	0.0001	0.00001	0.0002	MRLc
Cobalt	0.00003	0.000007	0.0001	0.00003	0.01	MRLi
Copper	0.0006	0.00005	0.0026	0.0002	0.02	MRLi
Iron	0.1158	0.0305	0.4633	0.122	NA	NA
Lead	0.0104	0.0008	0.0414	0.0031	NA	NA
Manganese	0.0112	0.0014	0.045	0.0054	NA	NA
Mercury	0.000008	0.0000007	0.00003	0.000003	0.007	MRLa
Thallium	0.000005	0.0000007	0.00002	0.000003	NA	NA
Vanadium	0.0002	0.00004	0.0006	0.0001	0.003	MRLi
Zinc	0.0075	0.0007	0.0299	0.0027	0.3	MRLi

Notes: Shaded doses exceed the corresponding health guideline or do not have health guidelines

Table D5 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for Residential Populations with non-Contaminated Properties Exposed West of the Box

Contaminant	Maximally Exposed Adult	Average Exposed Adult	Maximally Exposed Child	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.0119	0.0055	0.0475	0.0222	2	MRLi
Antimony	0.00009	0.000003	0.0003	0.00001	0.0004	RfD
Arsenic	0.0001	0.000009	0.0004	0.00004	0.005	MRLa
Cadmium	0.000008	0.000001	0.00003	0.000005	0.0002	MRLc
Cobalt	0.00003	0.000007	0.0001	0.00003	0.01	MRLi
Copper	0.0004	0.00002	0.0016	0.00008	0.02	MRLi
Iron	0.047	0.0149	0.1882	0.0598	NA	NA
Lead	0.0009	0.0002	0.0037	0.0007	NA	NA
Manganese	0.0042	0.0006	0.017	0.0026	NA	NA
Mercury	0.000001	0.00000008	0.000004	0.0000003	0.007	MRLa
Thallium	0.000005	0.0000007	0.00002	0.000003	NA	NA
Vanadium	0.0001	0.00002	0.0005	0.00009	0.003	MRLi
Zinc	0.0016	0.0002	0.0066	0.001	0.3	MRLi

Notes: Shaded doses exceed the corresponding health guideline or do not have health guidelines

Table D6 - Comparison of Estimated Exposure Doses to Health Guideline (milligrams per kilograms per day [mg/kg/day]) for non-Residential Populations Exposed West of the Box

Contaminant	Maximally Exposed Adult	Average Exposed Adult	Maximally Exposed Child	Average Exposed Child	Health Guideline Value	Health Guideline Source
Aluminum	0.0037	0.001	0.0146	0.0039	2	MRLi
Antimony	0.000006	0.000001	0.00002	0.000004	0.0004	RfD
Arsenic	0.00005	0.000005	0.0002	0.00002	0.005	MRLa
Cadmium	0.000008	0.000001	0.00003	0.000005	0.0002	MRLc
Cobalt	0.00001	0.0000009	0.00004	0.000003	0.01	MRLi
Copper	0.00003	0.000006	0.0001	0.00002	0.02	MRLi
Iron	0.0217	0.0045	0.0869	0.0181	NA	NA
Lead	0.0007	0.0001	0.0028	0.0005	NA	NA
Manganese	0.0025	0.0003	0.0098	0.0014	NA	NA
Mercury	0.000001	0.00000008	0.000004	0.0000003	0.007	MRLa
Thallium	0.000001	0.0000001	0.000004	0.0000005	NA	NA
Vanadium	0.00001	0.000002	0.00005	0.000009	0.003	MRLi
Zinc	0.0013	0.0002	0.0053	0.0008	0.3	MRLi

Notes: Shaded doses exceed the corresponding health guideline or do not have health guidelines

Table D7 – Health Implication Guidelines (milligrams per kilograms per day [mg/kg/day]) for Contaminants of Potential Concern at the CdA River Basin site in Shoshone and Kootenai Counties, Idaho.

Contaminant	RfD	NOAEL	MRLc	MRLi	MRLa	LOAEL Dose mg/kg/day	LOAEL Effect
Aluminum		62		2		130	Neurologic deficits
Antimony	0.0004					0.529	Vomiting
Arsenic	0.0003	0.0008	0.0003		0.005	0.014	Dermal hyperpigmentation Keratosis of skin
Barium	0.07	0.21	X	X	X		
Cadmium		0.0021	0.0002			0.0081	Increased systolic blood pressure
Chromium	0.003 (VI)	0.46 (III)	X	X	X	0.57 (VI)	Gastrointestinal disorders Hematologic disorders
Cobalt		0.6		0.01		1	Polycythemia
Copper		0.0272		0.03	0.02	0.03	Nausea and vomiting
Iron			X	X	X		
Lead		0.07	X	X	X	0.01	Decreased ALAD
Manganese		0.0048	X	X	X	0.059	Mild neurological signs
Mercury				0.002	0.007		
Thallium			X	X	X	0.08	Performance deficit
Vanadium				0.003			
Zinc	0.3		0.3	0.3	X	0.83	Hematologic disorders

Table D8 - Results of Comparison of Combined Estimated Exposure Doses (by contaminant) to Health Guidelines (milligrams per kilograms per day [mg/kg/day]) for Persons Residing and Performing Recreational Activities in the Coeur d'Alene River Basin site, Kootenai and Shoshone Counties, Idaho.

Contaminant	Health Guideline (mg/kg/day)				Cancer Class
	Value	Source	Exceeded by Estimated Exposure Dose East of Bunker Hill?	Exceeded by Estimated Exposure Dose West of Bunker Hill?	
Aluminum	2	MRLi	No	No	
Antimony	0.0004	RfD	No	No	D
Arsenic	0.005	MRLa	Yes	Yes	A
Barium	0.07	RfD	No	No	D
Cadmium	0.0002	MRLc	Yes	Yes	B1
Chromium	0.003	RfD	No	No	A
Iron	None	None	Not Applicable	Not Applicable	
Lead	None	None	Not Applicable	Not Applicable	B2
Manganese	None	None	Not Applicable	Not Applicable	
Mercury	0.007	MRLa	No	No	D
Nickel	0.02	RfD	No	No	
Silver	0.005	RfD	No	No	D
Thallium	None	None	Not Applicable	Not Applicable	
Vanadium	0.003	MRLi	No	No	
Zinc	0.3	MRLi	No	No	D

Table D9 – Summary of Recent Epidemiologic/Controlled Human Particulate Matter (PM) Exposure Studies of Specific Physiologic Endpoints.

Physiologic Endpoint	Observed Association with PM Exposure	Reference
Lung function	Small declines in lung function; large risk of substantial decrements Growth of lung function in children reduced	Pope 2000 Gauderman et al. 2000
Hypoxemia	No clear associations with blood oxygen saturation	Pope et al. 1999
Plasma viscosity	Increased risk of elevated blood plasma viscosity	Peters et al. 1997
Heart rate	Increased mean heart rate and odds of substantially elevated heart rate	Pope et al. 1999 Peters et al. 1999
Heart rate variability	Changes in cardiac rhythm Decrease in overall heart rate variability	Liao et al. 1999 Pope et al. 1999 Gold et al. 2000
Pulmonary Inflammation	Elevated white blood cell counts, band cells expressed as percent of polymorphonuclear leukocytes, neutrophils, platelets, lymphocytes, and/or eosinophils	Tan et al. 2000 Salvi et al. 1999 Ghio et al. 2000
RBC sequestration	Changes in hemoglobin adjusted for albumin suggest that inhalation of some components of particulate matter may cause sequestration of red cells in circulation by changes in RBC adhesiveness	Seaton et al. 1999
Heart arrhythmia	Increased risk of implanted cardioverter-defibrillator discharges	Peters et al. 2000

Notes: Partially adapted from Pope (2000)

Appendix E–Information on Lead Models

Lead Models

The extensive contamination of lead in the environment has resulted in the need to adequately address the potential for health effects resulting from exposure. Lead is unique in that there is a large amount of data available relating human health effects in terms of internal dose or blood lead levels (PbB). In an effort to assess potential health effects to persons living near and around lead sites, various mathematical models have emerged that attempt to predict blood lead levels based on site-specific information.

The EPA Integrated Exposure Uptake and BioKinetic (IEUBK) Model for Lead in Children is one such model that has been widely used (EPA 1994). The IEUBK model is a classical, computer-based multi-compartmental pharmacokinetic model with four distinct components that include exposure, uptake, biokinetic, and a probability distribution that applies a geometric standard deviation to estimate the distribution of PbB in populations of children ages 0-7 years. The model's predictive ability was assessed by Hogan et al. (1998) utilizing the dataset from the ATSDR multisite exposure study (ATSDR, 1995). The evaluation by Hogan et al. showed reasonably close agreement between the empirical data and the IUEBK predictions. The predicted geometric mean PbB concentrations were within 0.7 µg/dL of the observed geometric mean and the IEUBK-predicted risk of PbB levels exceeding 10 µg/dL were within 4% of observed values. In addition, the computer code used by the IUEBK has undergone independent validation and verification (Zaragoza and Hogan 1998).

ATSDR developed a framework that relied on regression analysis and published slope factors relating environmental media lead concentrations with PbB (Abadin et al. 1997, ATSDR 1999). Integration of exposures from all relevant pathways provide an estimate of exposure expressed as total blood lead. The intent of this approach was to provide a simple screening tool. The primary limitation of this method is the application across diverse sites.

Other models include the O'Flaherty and Leggett models. The O'Flaherty model is a physiologically based pharmacokinetic (PBPK) model of lead uptake and disposition in children and adults (O'Flaherty 1993, 1995). A central feature of the model is the growth curve, a logistic expression relating body weight to age. The model also incorporates mechanisms of lead interaction with bone formation. The Leggett model is a classical multi-compartmental PBPK model of lead uptake and disposition in children and adults (Leggett 1993). It includes a central compartment, 15 peripheral body compartments, and 3 elimination pools and age-dependent parameter values for infants through older adults.

The use of mathematical models can provide useful information to assist health assessors in determining potential health risks from lead exposures. A significant issue with all models is the inability to completely identify and define extremely complex exposure scenarios relative to source contributions and physiological and behavioral variability among the population of interest. Performance evaluation of models using collected site data can be problematic with respect to representative sampling and accuracy of the environmental and biological laboratory data results. The IEUBK model has been criticized for improper selection of default values including the geometric standard deviation to estimate the range of blood lead levels in a lead-exposed population of children, the selection of soil to dust transfer coefficients, and the lead bioavailability. In an assessment of remedial effectiveness at Bunker Hill, von Lindern et al. (2003) found that the IEUBK with default values over predicted observed values, but application of site-specific information improved the predictive performance of the model.

More information on the IEUBK model can be found in the National Academy of Sciences Megasite report available at:
http://fermat.nap.edu/books/0309097142/html/223.html

Appendix F–ATSDR Response to Public Comments

ATSDR received comments on the Bunker Hill Mining and Metallurgical Complex Operable Unit 3 Public Health Assessment, Public Comment Release (December 1, 2004), from 13 individuals, organizations, and agencies during the public comment period which ended on March 17, 2005. We thank all of those who took the time to comment. This appendix lists the public comments and our response to them.

To avoid repeating the same message, the comments are summarized and categorized prior to being addressed. Some comments contained page numbers that refer to the public comment release and not the final document. The summarized comments are presented in bold type to distinguish them from ATSDR's responses which follow each comment or group of comments. General comments that did not concern this public health assessment or the public health assessment process and did not require a response are not included.

ATSDR Response to Public Comments Received on the Bunker Hill OU3 PHA

1. **Given the history of health and environmental risk studies completed in this region over time and the cleanup actions in progress it is understandable that the area covered in this report is identified as OU3 and the Coeur d'Alene Basin. What is not clear reading this report is when statements made are generally about the entire area as described in the first paragraph of the executive summary (including the Spokane River) and when the intent is to make statements which are only relevant, for example, specifically in Idaho. We ask that added effort be made to make very clear where statements apply and where they do not.**

Response:

ATSDR now refers to the site as the Coeur d'Alene (CdA) River Basin.

2. **Executive Summary – A. The Site - The description of the site is misleading. In the first two paragraphs of the description, the "site" is described as covering 3,700 square miles and includes areas in Kootenai and Shoshone Counties in Northern Idaho. However, the first paragraph of the description describes the site as "extending from the Idaho/Montana border westward to the Spokane Arm of Lake Roosevelt in the State of Washington." The implication from the description in the Executive Summary is substantially the same as the description contained in Section 2.1 (DPHA p.11). In both descriptions, the implication is made that the entire area is contaminated with metals released during the mining and smeltering operations within the Coeur d'Alene River Basin. It is true that there are some parts of the land included within the 3,700 square miles have some contamination of heavy metals. However, it is not only erroneous, but potentially harmful to the economic well-being of the area to imply that the entire area is contaminated.**

   Generally, the contamination that represents a potential pubic health risk is along the south fork of the Coeur d'Alene River commencing in Mullan, Idaho in Shoshone County, Idaho down to the confluence with the north fork of the Coeur d'Alene River which, together the two forks form the Coeur d'Alene River which then flows into Coeur d'Alene Lake at or near the town of Harrison in Kootenai County, Idaho. Lake Coeur d'Alene empties into, and is the head of, the Spokane River which flows from Lake Coeur d'Alene generally westward. The Spokane River is located in Kootenai County, Idaho and in Spokane, Stevens and Lincoln Counties in Washington. It is incorrect, and potentially harmful, to imply that the entirety of Coeur d'Alene Lake and the entire Spokane River in Idaho and Washington is contaminated and represents a potential public health risk.

It is suggested that the DPHA refer to the "Bunker Hill Mining and Metallurgical Complex, Operable Unit 3" as the study area being investigated for the purpose of the DPHA. Furthermore, it is suggested that a specific caveat be included in the report noting that the entire area that has been studied is not contaminated as to represent a public health risk. Rather, specific portions of the study area are contaminated with heavy metals released from mining and smelting operations and some of those areas represent a potential public health risk.

Response:

ATSDR has made adjustments to the document which should better define the areas being studied in this public health assessment.

3. **References to the CdA River Basin site are inconsistent. Sometimes they appear to include the Spokane River, and other times they do not. Although the text states that "Operable Unit 3" is the more common terminology used to describe the area, in fact the "CdA River Basin site" or the "site" are the most common descriptors. The definition of the site, however, has not been standardized in the text.**

Response:

ATSDR has made adjustments to the document which should better define the areas being studied in this public health assessment.

4. **While the issue of whether to include the Spokane River as part of the "site" may be politically sensitive, the text needs to clearly delineate the involvement of the River in this document, state whether it is or is not part of the "site."**

Response:

ATSDR does consider the Spokane River as part of the CdA River Basin site as described in section 2.1 of the PHA.

5. **The report appropriately contains public health risk assessment statements but should also contain statements which make it clear that public health risk is only one reason that cleanup actions might be taken. Ecological risk, and ecological risk combined with human health risks can lead to cleanup action determinations which may superficially appear inappropriate given a perspective based only on the statements contained in this report. If these distinctions are not made clear, the report could be misconstrued or misunderstood**.

Response:

ATSDR's PHAs are reviews of available environmental and biological data to determine whether public health is impacted and what should be done if an impact exists. Ecological issues are reviewed by EPA.

6. Given a federal maximum level of acceptable risk, communities should have some say in what level of risk they choose to accept so long as their choice does not impose unacceptable risk to other communities. It is not clear how this report has taken community concerns regarding risk acceptance into account.

Response:

ATSDR is unclear about what you mean by "federal maximum level of acceptable risk". 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 disease related to toxic substances. The ATSDR PHA is the evaluation of data and information on the release of hazardous substances into the environment in order to assess any [past], current, or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects. The PHA is conducted to determine whether and to what extent people have been, are being, or may be exposed to hazardous substances associated with a hazardous waste site. Communities can use that information to determine what level of risk they are willing to accept.

ATSDR's PHA is advisory in nature. The PHA differs from the more quantitative risk assessment conducted by regulatory agencies, such as EPA. Both types of assessments attempt to address the potential human health effects of low-level environmental exposures, but they are approached differently and are used for different purposes. One needs to understand the differences to know how to interpret and integrate the information generated by each of these assessments.

The *quantitative risk assessment (RA)* is used by regulators as a part of site remedial investigations to determine the extent to which site remedial action (e.g., cleanup) is needed. The RA provides a numeric estimate of theoretical risk or hazard, assuming no cleanup takes place. It focuses on current and potential future exposures and considers all contaminated media regardless if exposures are occurring or are likely to occur. By design, it generally uses standard (default) protective exposure assumptions when evaluating site risk.

The *PHA* is used by ATSDR to identify possible harmful exposures and to recommend actions needed to protect public health. ATSDR considers the same environmental data as EPA, but focuses more closely on site-specific exposure conditions, specifically community health concerns, and any available health outcome data to provide a more qualitative, less theoretical evaluation of possible public health hazards. It considers past exposures in addition to current and potential future exposures.

The general steps in the two processes are similar (e.g., data gathering, exposure assessment, toxicologic evaluation), but the PHA provides additional public health perspective by integrating site-specific exposure conditions with health effects data and specific community health concerns. ATSDR's PHA also evaluates health outcome data, when there has been exposure at levels associated with an adverse outcome.

Remedial plans based on a RA represent a prudent public health approach—that of prevention. By design, however, RAs used for regulatory purposes do not provide perspective on what the risk estimates mean in the context of the site community. The PHA does. The process is more exposure driven. The process identifies and explains whether exposures are truly likely to be harmful under site-specific conditions and recommends actions to reduce or prevent such exposures.

The community associated with the Coeur d'Alene River Basin site is both an important resource for and a key audience in the public health assessment process. ATSDR has reviewed available environmental and biological data to determine possible impacts on human health. ATSDR has also met with community members to gather their health-related concerns. These concerns are addressed in section 8 of the PHA.

7. The ATSDR draft public health assessment is perceived by some as minimizing the seriousness of contamination and health effects. In light of the following comments please consider whether you have expressed a neutral point of view. Wording such as "contaminated sites occur only infrequently along the Spokane River" appears aimed at making the reader think that contamination is fine as long as it's only here and there. This type of wording occurs in sections throughout the report. Likewise, the Sampling Report (Appendix B) contains several such instances, particularly when the sampling and analysis results are reported. For example, on page 106, items 5, 6, and 7: Item 5 says that "contamination levels in the surface soils …exceed screening values for several metals. But item 6 says that lead is "arguably the contaminant of greatest concern…" and that the concentrations are "relatively low." Adjectives such as "arguably" and "relatively" are vague and subjective in interpretation. They tend to persuade the reader to accept a point of view that may not be supported by anyone other than the author. Item 7 states that "Of the many metals considered in the sampling, only arsenic had at least one concentration more than 10 times higher than the corresponding screening value." This minimizes the contamination of all the other metals and also leads the reader to believe that arsenic isn't so bad after all. This type of wording occurs throughout the Sampling Plan and should be recast to a neutral point of view.

Response:

Appendix B reviews and summarizes individual databases, studies and reports. ATSDR provides a qualitative evaluation of the public health hazard based on the data evaluated. In providing these summaries ATSDR and its contractors have made no attempt sway readers' points of view.

8. Revise the report layout to include figures of Operable Unit 3 to immediately follow the Executive Summary. The figures are currently too far removed spatially to be as useful to the reader as they should be. Revise the figures so that they are clearly labeled as Figures 1, 2, and 3. Include the tables in the text following the section where they are first called out—it's very confusing to have the tables referenced as an appendix that apparently pertains to both the text and to Appendix B. In addition, comprehension requires that the data be presented in closer proximity to the explanatory text.

Response:

ATSDR has over the years generated many layouts for this public health assessment. Given the large amount of information presented in this public health assessment, ATSDR believes that the current layout is appropriate. However, the figures have been appropriately numbered.

9. Add figures that show the locations of the contaminated sampling points and insert these at the appropriate points in the text.

Response:

Inclusion of such information in the text would not add to ATSDR's conclusions and recommendations. ATSDR was not provided this data due to individual privacy issues. Please refer to documents produced by EPA for more information on sampling and sampling locations.

10. The demographics described in Section 2.3 (commencing at DPHA p.13) is somewhat misleading. For example, references are made to figures by number. However, the figures are not numbered. Under Section 2.3.2.Land Use, the statement is made that "the majority of the Cda River Basin remains undeveloped." If the Basin includes the Spokane River in Idaho and Washington, such statement is clearly erroneous. The Spokane River in Idaho and Washington has been substantially developed, particularly in Kootenai County, Idaho and Spokane County, Washington.

Response:

ATSDR will assure that figures will be numbered in the next release of the PHA. The demographics section has been annotated to include populations within the state of Washington.

11. The demographics of the area adjacent to the Spokane River, from the border with Idaho to Lake Roosevelt have been entirely omitted from this report. They need to be described in the appropriate sections. Spokane is the largest city between Seattle and Chicago and it is not acknowledged anywhere in the risk assessment (except, perhaps, as a point on a map).

Response:

The demographics section of the PHA has been annotated to include populations within the state of Washington. This information was also included on the map of Area 5 which was included in the PHA for public comment.

12. **The references in several places (see page 28 and 34 for examples) in the draft document to the population density (dispersed) and land uses (undeveloped farmland) along the Spokane River from the State Line westwards is factually incorrect. Part of the risk assessment includes making determinations regarding the availability of contamination to reach receptors (e.g., people). There are subdivisions currently built and new ones under developing all along the river from Post Falls towards the Spokane city limits. In addition, the Centennial Trail, a highly popular hiking and biking trail runs directly along the floodplain boundary for a number of miles. Recreational users and local residents could be exposed to lead and other heavy metal contamination, at some levels, near some of the contaminated beaches as they recreate. The beach sites are the subject of ongoing Site Investigations because of metal concentrations in sediments that exceed state and federal guidelines - this is mentioned only in passing in the document**.

Response:

Much of the data used in the preparation of this report was obtained from EPA and sources in the state of Idaho. ATSDR, through its Cooperative Agreement Program, is preparing a public health consultation to address potential exposures to contaminants in sediments along the Spokane River in the state of Washington.

13. **In the Background, and elsewhere, the text states that the CdA River Basin "is composed of rural and undeveloped land" or that "The majority of the CdA River Basin remains undeveloped." In the past 5 years, the Basin has experienced a boom in the number of people moving into the area and the consequent development of the land in the area. This situation needs to be addressed—what are the health effects of a vastly higher population recreating on potentially contaminated areas and also building homes there (digging, dredging, dust generation, increased surface soil exposure) and drilling wells (contaminant plumes?).**

Response:

ATSDR has modified the PHA to acknowledge the rise in populations within the CdA River Basin (including Spokane, WA). The rise in population does not change ATSDR's conclusions regarding exposures at the CdA River Basin site.

14. **The demographics information provided on page 13 of the health assessment is very limited and does not include specific ethnic population data. Also, it would be appropriate to look at the number of people who use or recreate in the Spokane River and Coeur d'Alene Lake alongside those who live near the water**

bodies. The local Parks and Recreation Departments in Spokane and Kootenai Counties, as well as State Park Departments should have access to this type of data.

Response:

ATSDR considered residential and recreational users in its analysis of potential health impacts. ATSDR does not believe that this additional information would add to its overall conclusions and recommendations.

15. Health Risks related to Lead in the Spokane River - Underrepresented Communities -Has ATSDR considered any studies of specific ethnic populations in the Cd'A Basin (in addition to the Cd'A Tribe) to determine if additional exposures to heavy metals may be occurring due to cultural backgrounds and/or language barriers? Please consider such studies and include a discussion of such in the final draft of this report. Children playing in shoreline soils may be of particular concern.

Response:

Washington State Department of Health, in conjunction with the Spokane Regional Health District and the Washington State Department of Ecology have actively engaged immigrant and tribal communities on the Washington side of the Spokane River. They are the lead in Washington for these activities. In the past this has included developing translated materials and speaking to community groups through interpreters. They will continue to be the lead on these efforts in Washington State.

16. In describing the health effects of consuming aquatic and terrestrial biota, the text comments that "metals contamination levels tends to be lower in parts people usually eat (fillets) than in other parts, such as livers and kidneys." This statement minimalizes those groups who do eat the more contaminated organs. The CAC heard in a presentation that the local population of Slav immigrants has reached approximately 20,000 and that 98% of this group is likely to use the Spokane River for fishing. Only 28% are aware of Fish and Game regulations, and all commonly eat the skin and other organs. It is only through special educational seminars that they are trained to eat fillets only. Last year, these seminars reached less than 200 people. Likewise, locals (not just Native Americans) who eat waterfowl are likely to consume gizzards, livers and hearts. The dangers of consumption of these organs should be delineated rather than dismissed by stating that most people don't eat them.

Response:

The amount of aquatic and terrestrial biota consumed by people can be difficult to accurately estimate. It can vary by type of animal tissue ingested, age, sex, lifestyle, or health status. Wildlife tissue sampling studies reviewed by ATSDR are shown in table C32. Based upon these studies, a person would have to ingest a large amount of the organs and skin of the aquatic or terrestrial biota over a very long period of time to have a significant impact on blood lead levels.

17. General Public Involvement/Health Education - Please indicate in the health assessment how ATSDR is working with agencies (DOH, Spokane Regional Health, Ecology, Idaho Dept of Health, Basin Commission, etc) to develop health education programs, activities and materials to follow up on recommendations in this health assessment. Please indicate whether or not there will be an opportunity for both Idaho and Washington citizens to provide input into these health education programs, activities and materials.

Response:

ATSDR and partner agencies are currently developing health education plans for the CdA River Basin site. Once these plans are drafted, the community will be given an opportunity to provide input before finalization.

18. Knowledgeable members of the Spokane community have raised the following specific technical issues for which the WCAC has an interest in seeing your response: [should these underlines be removed?]

Health Guidelines/Study Data

- **Pages 55 to 63 deal with health outcome data. On page 61 the study states, "…the true number of those with blood lead in excess of 10ug/dl may never be established." This remains an important issue and should be stated as such. There continues to be confusion between EPA's target of 5% risk vs. incidence. This report should clarify the difference in addition to stating that there are no controlled scientifically valid public health studies that determine the current true incidence of children with lead levels greater than 10ug/dl.**

Response:

Participation in blood lead testing programs within the CdA River Basin is voluntary. For this reason alone the true incidence of elevated blood leads in children may not be possible to establish.

- **When commenting on the public health risk of exposure to lead, out dated and irrelevant studies are quoted.**

Response:

ATSDR has updated the references cited.

19. The report states on page 39 that a past ATSDR study indicates that for each increase of 1000 ppm soil/dust contamination there is an expected blood lead level in children of 2-16 ug/dl. The ATSDR report states that they did not receive enough data to establish a correlated between environmental lead,

exposure and blood levels. They instead turned to the Stuik study to justify safety conclusions. Would ATSDR not have correlate information in their own study that determined the expected blood lead level for 1000 ppm lead exposure mentioned above, giving a more appropriate "level"?

Response:

Several studies indicate that the increase in blood lead concentration as a function of soil lead concentration is not linear. That is, at higher soil lead concentrations, the rate of increase in blood lead levels is not as great (Shilling and Bain, 1989). According to this study, an increase in soil lead concentrations from 100 ppm to 1,000 ppm was linked to a change of the predicted blood lead level from 7.3 µg/dL to 13.0 µg/dL, an increase of 5.7 µg/dL. However a soil lead concentration of 2,100 ppm was linked to an estimated blood lead level of 15.2 µg/dL, a change of 2.2 µg/dL.

20. Title Page; The title of the DPHA has some obvious errors and implies misinformation. The Bunker Hill Mining and Metallurgical Complex is not known as the Coeur d'Alene River Basin Site. Smelterville is not a county in Idaho. The Coeur d'Alene River Basin is in Kootenai and Shoshone Counties in Idaho. Smelterville is a town in Shoshone County. The title excludes any reference to Washington State.

Response:

The document title was changed incorrectly prior to being released for public comment. The corrected title has been added to this release of the PHA.

21. Pg. 1; A. The Site; last paragraph: add Lake Spokane

Response:

This information has been added to the document.

22. Pg. 2; Surface Soil & Household Dust; paragraph 2: Can you be more definitive about the percent of tests exceeding 400 ppm lead? Is there a relationship between yard samples exceeding 400 and household dust samples exceeding 400?

Response:

ATSDR has recommended that medical monitoring, such as blood lead testing, be considered for children residing within the CdA River Basin. Intervention programs should also continue. If elevated blood lead levels are found, other sources of lead should be assessed. Environmental lead levels, at locations where children with elevated blood leads live, should be compared with actual blood lead levels.

23. Pg. 3; Aquatic Biota; Paragraph 2 & 3: Seems this would be a place to add information the different risks posed to immigrant groups found in the Spokane area.

Response:

ATSDR has already discussed impacts from long- and short-term exposures to site contaminants in the PHA. Inclusion of discussion of risks for multiple immigrant groups is beyond the scope of the PHA and would not affect ATSDR conclusions and recommendations for this site.

24. The health assessment mentions a fish consumption advisory for Lake Coeur d'Alene due to high heavy metal content (p. 3). Is there or should there be a heavy metals public health advisory for Spokane River fish on the Idaho side of the River.

Response:

ATSDR does not currently have fish sampling data for the Idaho side of the Spokane River. Should such data become available, ATSDR will evaluate the data and determine appropriate public health actions based upon its analysis. However, based on data from fish sampling and the fish consumption advisory in effect for the Washington side of the Spokane River and Lake CdA, ATSDR recommends that consumers of fish caught in the waters of the Spokane River on the Idaho side follow the advice given in the Washington and Lake CdA fish consumption advisories.

25. The Washington State Dept of Health has issued a public health advisory for shoreline sediments, warning people to wash off when playing on certain beaches along the Spokane River due to heavy metals contamination. This public health advisory should be referenced and discussed in this report. If there is a disagreement between WDOH and ATSDR regarding the amount of exposure or amount of risk to recreational users on the Spokane River please indicate this in the public health assessment.

Response:

Washington State, through its Cooperative Agreement with ATSDR, has completed a public health consultation regarding exposure to sediments along the Spokane River. The results indicate that a health hazard exists from the potential for direct human contact with lead contaminated sediments through recreational and other types of activities along the shoreline of the Spokane River. The public health consultation supports the use of health advisory signs along the Spokane River, and cleanup efforts of the Washington Department of Ecology.

26. Pg. 6; Current Exposures: "Data from populated areas west of Lake Coeur d'Alene…currently poses no apparent public health hazard." This statement needs explanation given EPA and WA State cleanup plans in Washington for

contaminated beach areas, and given the Spokane Regional Health District's posted warnings.

Response:

The text has been modified as follows:

Data from populated areas within the state of Idaho and west of Lake Coeur d'Alene, however, indicate that the site currently poses **no apparent public health hazard**.

27. Pg. 6; Exposures for Residents: Questions have been raised in some of our other comments about the risk posed to those who would consume whole fish, or subsist on fish and wildlife contaminated with metals. This issue should be addressed and conclusions should be stated at this point in the document.

Response:

This issue was addressed in detail in ATSDR's public health consultation titled: Evaluation of Metals in Bullhead, Bass, and Kokanee from Lake Coeur d'Alene. The link for the document can be found in appendix I of this PHA. It is referenced and summarized throughout this PHA.

28. Pg. 6; bottom of page: " The data show that recreation at Lake Coeur d'Alene represents no apparent public health hazard." This statement calls into question the need for cleanup actions at recreational sites – actions which are currently being taken.

Response:

The information contained in that section of the document pertained to visitors who would use the Lake and adjacent CUAs for recreational purposes (recreational users with no chronic residential exposure) intermittently and for short durations. As stated in the section just prior, exposure of residents (especially those with other sources of lead exposure) to contaminants in the surface waters, sediments, biota, etc. may result in increased risk of additional exposures and possible cumulative health effects. Therefore, these individuals should exercise caution when recreating throughout the CdA River Basin.

The quantitative risk assessment is used by regulators as part of site remedial investigations to determine the extent to which site remedial actions (e.g., cleanup) is needed. The risk assessment provides a numeric estimate of theoretical risk or hazard, assuming no cleanup takes place. It focuses on current and potential future exposures and considers all contaminated media regardless if exposures are occurring or are likely to occur. By design, it generally uses standard (default) protective exposure assumptions when evaluating site risk.

The PHA is used by ATSDR to identify possible harmful exposures to recommend actions needed to protect public health. ATSDR considers the same environmental data as EPA, but focuses more closely on site-specific exposure conditions, specific community health concerns, and any available health outcome data to provide a more qualitative evaluation of possible public health hazards. It considers past exposures in addition to current and potential future exposures.

The general steps in the two processes are similar (e.g., data gathering, exposure assessment, toxicologic evaluation), but the PHA provides additional public health perspective by integrating site-specific exposure conditions with health effects data and specific community health concerns.

Remedial plans based on a quantitative risk assessment represent a prudent public health approach—that of prevention. By design, however, quantitative risk assessments used for regulatory purposes do not provide perspective on what the risk estimates mean in the context of the site community. The PHA process is more exposure driven. The process identifies and explains whether exposures are truly likely to be harmful under site-specific conditions and recommends actions to reduce or prevent such exposures.

29. The DPHA discusses exposure to metals for Basin "visitors". It is clear that ATSDR is referring to recreational users. However, the use of the term "visitors" implies that those persons who reside in the area are different. It is requested that ATSDR use the term "recreational users" rather than the term "visitors".

Response:

The document has been modified and the term "recreational user" has been substituted for the word visitor as appropriate.

30. Pg. 7; the statement is made that eating fish or shellfish caught in the Spokane River may represent a health hazard because the fish may contain PCBs. The statement is based upon a reference to "WDOE 1995" which is, in fact, a Washington State Department of Ecology Report on the 1993-1994 investigation of PCBs in the Spokane River – Publication No. 95-310. Since the 1993-1994 investigation of PCBs was conducted and the WDOE 1995 publication was published, substantial additional information has been obtained and provided to the Washington State Department of Ecology regarding PCBs in the Spokane River. If you are not already aware of this data please contact Washington Department of Ecology. ATSDR is requested to include, in the PHA, a statement substantially as follows: "Federal and State agencies, including ATSDR, should review additional environmental data, including surface water and biodata as it becomes available, and make such determinations regarding possible health implications that are appropriate based upon the additional data." See recommendation 12 in the DPHA at p.74.

Response:

Since the Spokane River up to the Spokane arm of Lake Roosevelt is considered part of the CdA River Basin site, recommendation 12 in the public comment release PHA addresses this comment. However, it should be noted that the PCB contamination is not related to former mining and smelting activities within the CdA River Basin. Questions regarding this contaminant should be directed to the Washington State Departments of Ecology and Health.

31. Pg. 7; 3rd Paragraph: A fair amount of PCB data have been generated in recent years. Given the existing data, available at Ecology, are the current health advisories appropriate?

Response:

PCBs are not related to past mining and smelting activities in the CdA River Basin, and ATSDR did not request or analyze such data. However, we referred this question to the Washington State Department of Health and they have indicated that it is still appropriate. For further information on this contaminant, or others not related to the CdA River Basin, please contact the Washington State Department of Health.

32. The executive summary of the assessment states that there are no health risks west of Lake Coeur d'Alene. But in that same summary, ATSDR states on page 7 (referring to the Spokane River), that "…occasional, short-term exposures to metals in contaminated water represents no apparent public health hazard." Please specify whether ATSDR is referring to the water, sediments or surface soil when determining exposure routes. Please specify in your final draft health assessment whether there is "no health risk" or "no health risk to short-term occasional exposures."

Response:

After reviewing the health consultation prepared by the Washington State Department of Health, under cooperative agreement with ATSDR, on the Spokane River sediments, we retract the statement that no health risk exists west of Lake Coeur d'Alene and the document has been modified.

33. Pg. 7; G. Recommendations; bullet 2: The statement "particularly in areas east of the Box" is inconsistent with the statement about children living in the lower basin west of the Box at page 61, paragraph 1.

Response:

ATSDR could not find the stated inconsistency. The basis of the recommendation is the concentration of lead in play area soil based on the data reviewed by ATSDR and has nothing to do with the statements regarding blood lead levels in children tested throughout the CdA River Basin.

34. Pg. 8; section G; bullet 4: Does ATSDR have any recommendations on the way blood lead levels should be acquired (i.e. testing at fixed locations & times?, payment for testing?)?

Response:

ATSDR and CDC's National Center for Environmental Health will assist the Basin Environmental Project Improvement Commission, IDEQ, IDH, PHD, and EPA to plan an appropriate blood-lead monitoring program for young children in high risk areas for lead poisoning and other environmental contaminants, if requested.

The ideal program would integrate a blood-lead monitoring program that strengthens the infrastructure and capacity of the area's overall remedial, housing and public health activities. Examples of local partnerships may include Women and Infant Care, MEDICAID (Early Period Screening, Diagnostic, Treatment), Immunization, and Early Head Start.

35. Pg. 11; references are made to Figures 1, 2 and 3. The figures are included in Appendix A to the DPHA. Except for Figure 1. Site Location Map, the figures are not numbered. This needs to be corrected.

Response:

This error has been corrected.

36. In the second "bullet" on page 11, reference is made to the North Fork Cda River as an area which is "west of the Box". The North Fork of the Coeur d'Alene River is not "west of the Box" but is rather a separate fork of the Coeur d'Alene River which, together, form the Coeur d'Alene River at Enaville or near Kingston, Idaho. The Coeur d'Alene River, then flows west to Lake Coeur d'Alene.

Response:

Thank you for drawing ATSDR's attention to this erroneous statement. The paragraph has been modified to read as follows:

Areas west of the Box—Includes the drainage basin for Pine Creek and the region surrounding the confluence (near Kingston, Idaho) of the North Fork CdA River (which is actually north of the Box) and South Fork CdA River (downstream of the Box), tributaries flowing into the South Fork CdA River at the Box, Lake Coeur d'Alene and the entire length of the CdA River. It also includes the towns of Kingston and Harrison, the area known as the "Lower Basin," and the lateral lakes along the CdA River, roughly from the towns of Cataldo to Harrison. These lakes include but are not limited to Anderson Lake, Blue Lake, Black Lake, Swan Lake, Cave Lake, Medicine Lake, Killarney Lake, Bull Run Lake, and Rose Lake.

This PHA also discusses the Spokane River and the Trail of the Coeur d'Alenes (TCdA) including the segment from Harrison to Chatcolet. The area of the Spokane River reviewed covers river segments within the State of Idaho westward to the Spokane arm of Lake Roosevelt in the State of Washington (Figure 4).

37. Pg. 13; Demographics: This would seem to be the place to mention ethnic communities in the Spokane area who, because of cultural differences, may be at greater risk than others. In addition, some mention of the poor and homeless who camp along the rivers would also seem to be warranted.

Response:

ATSDR has already discussed impacts from long- and short-term exposures to site contaminants in the PHA. Inclusion of discussion of risks for multiple immigrant groups and the homeless is beyond the scope of the PHA and would not affect ATSDR conclusions and recommendations for this site. However, ATSDR is currently addressing possible exposures to subsistence populations. Attempts to locate relevant information on Washington State based ethnic groups were unsuccessful. ATSDR will work with the Washington Citizens Advisory Group to identify relevant data resources for Washington State based populations, if available.

38. There is inference that aluminum and vanadium values exceeding water quality guidelines are the result of mining contamination (see page 20) and there is no substantiation of this inference. Other sources are likely.

Response:

ATSDR does not see where such an inference was made and none was intended. That paragraph simply summarizes the results of sampling studies conducted by EPA and its contractors.

39. Pg. 21; paragraph 3: Might note here the added risk to those who might use the whole fish

Response:

This information has been summarized in the appropriate sections of this PHA. In addition, ATSDR's health consultation on evaluation of metals in fish taken from Lake CdA (see appendix I for link) covers this subject in detail.

40.Pg. 32; 4.1.7; 2nd sentence: Where can people learn about contaminant levels in select biota?

Response:

That information was contained in the public health consultation on evaluation of metals in bullhead, bass, and kokanee from Lake Coeur d'Alene which was included in the public comment version of this PHA as a supplemental document in appendix H.

41. In this public health assessment, ATSDR alludes to the cumulative effect of all these exposures to lead from various sources (pp. 39-43). However, the assessment does not clarify which people in which parts of the Basin are most at risk. WCAC believes that socio-economic background plays a role in increasing risk of exposure to lead. We feel this should be explored in the final draft of the health assessment.

Response:

ATSDR agrees that socio-economic factors play a role in exposure. As was stated in the document, health effects resulting from the interaction of an individual with a hazardous substance in the environment depend on several factors. One is the route of exposure. That is, whether the chemical is inhaled, ingested (swallowed), or touched by the skin (i.e., dermal contact). Other factors include how long the exposure occurs, the dose to which a person is exposed, and the amount of the substance that is actually absorbed. Mechanisms by which the environment or the body alters chemicals, as well as the combination of chemicals, are also important. Once exposure occurs, characteristics including a person's age, sex, nutritional status, genetics, lifestyle, and health status may influence how the body absorbs, distributes, metabolizes, and excretes contaminants.

42. Pg. 40; footnote 19: Where did the IEUBK results come out in comparison to the other two methods used in the calculations?

Response:

Use of the intake of concern and IEUBK model resulted in a higher estimate of children with elevated blood lead levels than had been seen in the State's Exposure Assessment and annual blood lead screening in the Basin. However, the annual screen does not represent the entire population.

43. On page 42 of the DPHA, the statement is made that "Lead was also detected in the surface water, sediments, and surface soils of the Lake Coeur d'Alene area . . . . " This implies that the entire area of Lake Coeur d'Alene is contaminated with lead. Is this a true statement? Why should the entire "Lake Coeur d'Alene area" be stigmatized with the implication that it is contaminated with lead? Rather, shouldn't the statement be that on some beaches, particularly those near the outlet of the Coeur d'Alene River, are contaminated with lead?

Response:

Thanks you for your comment. Your comment along with recommendations made in the National Academy of Sciences Report (NAS 2005) has lead ATSDR to clarify statements made in the PHA so that it is apparent that not all areas and media within the CdA River Basin site are metal-contaminated. ATSDR has revised the statement to read as follows: "Lead was also detected in some surface water, sediments, and surface soils samples from the Lake Coeur d'Alene area (particularly those areas near the outlet of the CdA River)…"

44. The report states (see pg. 70) that the health effects risk from lead and other metal contamination in the Spokane River is, at present, minimal. Lead, however, is at levels sufficient to cause the warning for consumption of crayfish (last sentence, page 42). These appear to be inconsistent statements.

Response:

The statement on page 42 now reads:

> *"On the basis of fish and shellfish samples from the Spokane River to date and relevant exposure estimates, ATSDR does not anticipate adverse health effects from metals contamination from the consumption of fish fillets from river fish caught west of the Upper River dam. ATSDR agrees with the State of Washington and does not recommend consumption of Spokane River fish caught east of Upper River dam. ATSDR does not recommend consumption of whole fish as lead concentrates in bone tissue. In addition, based upon currently available data, eating very large quantities of local crayfish could increase a person's overall body lead burden.*
>
> *As stated throughout this report, persons at risk of multiple exposure sources for lead should try to eliminate as much exposure to lead as possible. This is especially true for children and pregnant women. Therefore, ATSDR believes that residents who must face multiple sources of metals exposure* should eliminate or drastically decrease their consumption of locally caught fish or shellfish*. Taking this precaution will reduce their chances of developing adverse health effects caused by the cumulative exposure to individual metals."*

The statement on page 70 now reads:

> *"Aquatic biota caught in some areas of the Spokane River represent a public health hazard especially for children, pregnant women, and women who are considering pregnancy. The State of Washington has issued a public health advisory for fish caught in the Spokane River because of the presence of lead and PCBs.*[36] *ATSDR does not recommend the consumption of whole fish as lead concentrates in the bones. ATSDR is unable to determine if fish caught in other Basin water-bodies in Washington state would pose a public health hazard due to lack of sampling data."*

Under a non-subsistence scenario, ATSDR estimates that *fillets* of sampled fish species from the Spokane River east of Upper River dam, when eaten in moderation, would not pose a significant health hazard. The exceptions are the

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[36] Note: This contamination is not thought to be related to mining wastes.

special populations noted above. Consumption of *whole fish* should be avoided. This is especially true for the above special populations.

45. Pg. 42; With regard to metals and the cleanup levels chosen by EPA for the beach areas in Washington on the Spokane River – it is our understanding that the cleanup level was reached by application of the IEUBK model. Why does your conclusion indicate no adverse health hazard expected when the modeling indicated a cleanup level which is (before cleanup) exceeded in a number of locations?

Response:

After reviewing the health consultation prepared by the Washington State Department of Health, under a cooperative agreement with ATSDR, on the Spokane River Sediments, we retract the finding of no adverse health risk for the Spokane River and modify the public health assessment accordingly.

46. Pg. 42; Given that Washington State's Model Toxics Control Act gives preliminary cleanup levels for lead contaminated residential sites that is significantly lower than the beach cleanup levels that resulted from EPA's modeling (250 mg/kg versus 700), and given the ATSDR finding of no adverse health effect, please explain the difference.

Response:

After reviewing the health consultation prepared by the Washington State Department of Health, under a cooperative agreement with ATSDR, on the Spokane River Sediments, we retract the finding of no adverse health risk for the Spokane River and modify the public health assessment accordingly.

47. Pg. 42; 5th paragraph: As there is some indication that certain ethnic communities in Spokane may consume whole fish, wouldn't it be appropriate to mention that possibility and its risk consequence here as well?

Response:

ATSDR has added this consequence to this section of the PHA. However, in the public health consultation (see appendix I for link), ATSDR covers this pathway of exposure in detail. It is recommended that whole fish not be consumed given that lead concentrates in bones.

48. Pg. 43; 5.2.2 Exposure to Arsenic-East of the Box; paragraph 2: Is there no increased risk of skin cancer? Or other cancer risk as a result of exposure to arsenic? (See also page 113.)

Response:

According to EPA and the U.S. Department of Health and Human Services, arsenic is known to cause cancer in people. This conclusion is based on convincing evidence from many studies of people who were exposed to either arsenic-contaminated drinking water, arsenical medications, or arsenic-contaminated air in the workplace. Of the different types of cancer from oral exposure, skin cancer—namely, squamous cell carcinoma and basal cell carcinoma—and other types of cancer, including cancer of the lungs, bladder, kidney, and liver, are a concern.

One way to evaluate the cancer-causing potential from arsenic in soil is to estimate the average amount of arsenic-contaminated soil that people ingest over many years and use mathematical equations to estimate a theoretical increase in cancer risk. EPA typically uses this approach to estimate a potential increased risk of cancer from estimated exposure doses.

A key parameter in this calculation is the cancer slope factor, which, for arsenic, was derived from arsenic exposures via drinking water and skin cancer cases reported in a Taiwanese study (ATSDR 2000g). Using the estimated dose from soil ingestion for 30 year for adults, the mathematical model suggests that an increased risk of cancer might exist for long-time residents at some of the properties east of the Box. For example, for adults who live at a property with an average soil arsenic concentration of 100 ppm, the model predicts an increased risk of zero to two extra cases of cancer for every 100,000 adults who ingests soil over a 30-year period. The average concentration of arsenic in residential surface soil east of the Box was 33 mg/kg. Even if the maximum concentration of 1,700 mg/kg is used in the model the predicted increased cancer risk over a 30-year period would be zero to three extra cases of cancer for every 10,000 people. Based on these calculations, ATSDR does not expect any significant increased risk of carcinogenic effects to occur.

49. Pg. 52; paragraph 1: Are the PCB health advisories for the Spokane River and Lake Spokane in WA still appropriate?

Response:

PCBs are not related to past mining and smelting activities in the CdA River Basin, and ATSDR did not request such data. However, we referred this question to the Washington State Department of Health and they have indicated that it is still appropriate. For further information on this contaminant, or others not related to the CdA River Basin, please contact the Washington State Department of Health.

50. Pg. 52 of the DPHA, ATSDR again cites the WDOE 1995 report noting that there is PCB contamination in fish caught in the Spokane River. The statements made in the DPHA apparently relate to PCB contamination. Is the statement "some such as rainbow trout and mountain whitefish caught between Upriver Dam and the Washington/Idaho state line should not be eaten at all" a correct statement? As discussed earlier and as stated in recommendation number 12 on page 74, it should be noted that there is additional information that is available relating to contamination and that should be studied by ATSDR and federal and

state agencies to determine whether the conclusions reached regarding PCBs are appropriate with the additional data. See also Section 9.1.2 at page 70 relating to the Spokane River and PCBs. The same statement should be noted.

Response:

The statements made are quoted from the State-issued fish consumption advisory. As noted above, PCBs are not related to past mining and smelting activities in the CdA River Basin, and ATSDR did not request or analyze such data. For further information on this contaminant or others not related to the CdA River Basin site, please contact the Washington State Departments of Health or Ecology.

51. Arsenic in groundwater in the Hanley well (see page 113) is briefly discussed. Further discussion is warranted as to the circumstances surrounding the occurrence.

Response:

As discussed in the PHA, this contamination is not believed to be site related. Inclusion of that sort of discussion would not affect ATSDR's conclusions and recommendations for this site.

52. The Golder and Associates and USGS work on the hydrologic environment of the Spokane River in the State Line indicates the river's hydrologic regime (losing-gaining reach segments) changes rather abruptly in the same location that the largest and most intense heavy metal contamination occurs in beach sites along the river's course. Despite some published accounts, there is still considerable debate in the scientific community as to the character of the contamination as the geochemical signature suggests a single point source type of contaminant source (the sudden appearance of high contaminant values and very rapid drop in values from the upstream areas where the highest numbers occur). Specifically, the occurrence of high arsenic values at the state line beach locations is not particularly typical of mine wastes throughout most of the Coeur d'Alene basin and would suggest the arsenic may have another source. That source whatever its origin may account for the high arsenic levels there, whether from releases from municipal or other industrial sources, past riverside orchard's use of lead arsenate, natural deposits, etc. and may still pose a threat of continued recontamination of the beaches if the source(s) are not identified. Further discussion is warranted in the context of the public health assessment.

Response:

The scope of ATSDR's PHA is to focus on the contaminant levels and their potential for human health impacts. Sources of contamination do not change their health effect. Therefore, ATSDR does not address sources in its PHA. EPA, local and state regulators determine the responsible parties for contamination.

53. One of the main observations is that the ATSDR study is extremely vague. In fact it breaks new ground in the vagueness category.

Response:

Comment noted.

The focus of this PHA is lead issues within the CdA River Basin. Most modern references to the health effects of lead are based upon blood lead concentrations. Such data is not widely available for the CdA River Basin site so ATSDR had to rely on limited biological data and environmental data. A thorough analysis of the site based upon a comparison of these two datasets was impracticable for the following reasons:

- The blood lead data are collected through voluntary participation in a blood lead screening program compared to the systematic way that the soil lead data were obtained, which could introduce uncertainty into any analysis. Children whose parents chose to have them tested may have a significantly different chance of living at a location with elevated soil lead levels than those children whose parents chose not to have them tested. Therefore any analysis might not reflect the actual relationship between blood and soil lead levels.

- The relationship between blood and soil lead levels is more complex than what can be demonstrated through simple comparison of blood and soil lead levels at the same location (provided the information were made available). As indicated on page 262 of the ATSDR Toxicological Profile for Lead (ATSDR 1999a), "*The relationship depends on depth of the soil sampled, sampling methods, cleaniness of the home, age of the children, and mouthing activities, among other factors.*" In addition, the amount of soil contact that a child may have is likely to vary depending on season of the year. A reasonable way to address the problem is to collect data on lead levels in soil, blood, household dust, water, and other media at the same time, then analyze. Such an investigation is beyond the scope and purpose of a PHA.

The results of such analyses would not change or help refine the recommendations and public health action plans proposed in this PHA.

54. The study speaks of risks to tourists and to residents but the risks are not quantified. Are the risks important or not? In order to rationally make that judgment, one must know the risk in quantifiable units.

Response:

The quantitative risk assessment is used by regulators as part of site remedial investigations to determine the extent to which site remedial actions (e.g., cleanup) is needed. The risk assessment provides a numeric estimate of theoretical risk or hazard, assuming no cleanup takes place. It focuses on current and potential future exposures and considers all contaminated media regardless if exposures are occurring or are likely to occur. By design, it generally uses standard (default) protective exposure assumptions when evaluating site risk.

The PHA is used by ATSDR to identify possible harmful exposures to recommend actions needed to protect public health. ATSDR considers the same environmental data as EPA, but focuses more closely on site-specific exposure conditions, specific community health concerns, and any available health outcome data to provide a more qualitative evaluation of possible public health hazards. It considers past exposures in addition to current and potential future exposures.

The general steps in the two processes are similar (e.g., data gathering, exposure assessment, toxicologic evaluation), but the PHA provides additional public health perspective by integrating site-specific exposure conditions with health effects data and specific community health concerns.

Remedial plans based on a quantitative risk assessment represent a prudent public health approach—that of prevention. By design, however, quantitative risk assessments used for regulatory purposes do not provide perspective on what the risk estimates mean in the context of the site community. The PHA process is more exposure driven. The process identifies and explains whether exposures are truly likely to be harmful under site-specific conditions and recommends actions to reduce or prevent such exposures.

55. ATSDR did Coeur d'Alene Lake fish studies and reported no big problems in eating fish. Now ATSDR endorses an EPA fish study which basically says not to eat the whole fish, parts and all [Duh]. A commentary on the fish advisories is attached.

Response:

The first study looked only at fillets from fish in the lateral lakes and found no problem which is consistent with the Lake Coeur d'Alene study. ATSDR makes its recommendations based upon available fish data. Based upon data reviewed by ATSDR some fish can be consumed in moderation, however, only fillets should be ingested. ATSDR does not recommend consumption of whole fish due to the fact that lead concentrates in bone tissue.

56. Summary doesn't accurately depict the document.

Response:

This is a summary and as such not everything can be mentioned. The focus of the summary is on the information relevant to the conclusions and recommendations.

57. Ethics of circling the wagons with EPA and trying to influence the current NAS study are questionable.

Response:

ATSDR has attempted to provide in the PHA an independent evaluation of available environmental sampling and biologic data from a public health perspective.

58. It must be recognized that the authority of science flows from the following of adequate scientific procedure or methods and, in consequence, that authority will not attach to assertions that flowed from the application of bureaucratic authority [even ATSDR staff in their imposing uniforms], where the two were in conflict. The current ATSDR study actually does a lot of damage to the authority of ATSDR.

Response:

Comment noted. The pure scientific method cannot be applied to the public health assessment. This is applied science and public health practice.

59. In regard to your public health assessment in the Coeur d'Alene Basin (Silver Valley. The banks of the Cd'A river, "southfork", known to me only as lead creek, flowed completely gray in color and the bottom was 6" deep in a clay the same color. A kids toy being played in the sand nearby and touched by wet hands or placed in the mouth got a kid lead poisoning. At the age of 18 months I went through that in a local hospital for 10 days. High fever, coma and all. It's still there. You can't get it all. Leave it as is. Put up warning signs.

Response:

Thank you for your comment. The purpose of the PHA is to convey information to prevent/mitigate exposure to contaminated media. To this end basic public health communication statements have been placed throughout the CdA River Basin site PHA. Basic public health precautions such as hand washing are stressed. In addition, information which is of particular interest to potentially exposed/effected community members is often reiterated.

ATSDR is a non-regulatory agency. ATSDR makes recommendations that address issues of human health significance to regulatory agencies, however, ATSDR leaves the method of addressing the issue to the regulatory agency involved. ATSDR has recommended additional signage.

60. Page 2 Potable Water Sources **Although not evaluated by CERCLA processes, illnesses from biological pathogens would be of concern for people ingesting surface water. People consuming surface water may also lack adequate septic or sewer services compounding risks from water-borne pathogens.**

Response:

ATSDR agrees that proper precautions should be taken. ATSDR has recommended additional signage.

61. Ambient Air Revise text to clarify that cadmium is not one of the six Clean Air Act National Ambient Air Quality Criteria pollutants.

Response:

Thank you for your comment. The section now reads:

The ambient air concentrations of particulate matter contamination in CdA River Basin site have changed considerably over the last 30 years. Concentrations of sulfur dioxide and lead often exceeded EPA's air quality standards in the 1970s. Concentrations of cadmium also exceeded screening values during that time period. Although levels continued to exceed the standards and screening values, in 1980, ash from Mount Saint Helens in Washington contributed to the poor air quality detected at the time. These levels greatly diminished after 1981, when many industrial activities ended. Currently air quality in the site vicinity is within EPA's air quality standards and ATSDR screening values.

62. Completed Exposure Pathways Clarify links between lead-contaminated soil and dust and elevated blood leads. As currently stated, (e.g., contamination found & some children are elevated), no connection is made.

Response:

Thank you for your comment, however, this is a summary and as such not everything is mentioned. The focus of the summary is on information relevant to the conclusions and recommendations. The association between soil and dust concentrations of lead and blood lead levels has been discussed extensively in the main body text of the PHA.

63. Other Completed Pathways Clarify that inhalation of airborne contaminants is no longer a complete exposure pathway.

Response:

Thank you for your comment. This clarification has been made.

64. Page 5 Potential Health Effects Qualify the relatively low blood lead screening participation rates rather than referring generically to "…some area children who participated in a screening program …".

Response:

Text now reads: *"Of the children tested in 1990, 37% had blood-lead levels over 10 µg lead/dL of blood. Of the children tested in 2002, that percentage had dropped to 2%. This drop may be the result of several factors, and the summary statistics alone do not allow ATSDR to determine precisely whether the drop in blood-lead levels stems from remedial or educational efforts or from some other factor. During summer 2003, nearly 7% of the 75 children tested had blood-lead levels ≥10 µg/dL. Thus ATSDR believes that there may be other children residing* *within the CdA River Basin with elevated blood lead levels that have not been tested.*"

65. Page 10 Data Collection and Compilation Distinguish between data compilation and data to collection to highlight areas where data was collected by ATDSR.

Response:

Thank you for your comment. ATSDR has revised this section of the document to address the issue you raised.

66. Page 23 Plants The description of cadmium in plants contradicts statements in the Executive Summary (p 4).

Response:

Thank you for bringing this error to ATSDR's attention. The document has been appropriately revised.

67 Page 27 Ingesting household dust and surface soils Suggest replacing *accidental soil ingestion* with *inadvertent soil ingestion*. *Accidental* implies an unwarranted level of awareness and control.

Response:

Thank you for your suggestion, ATSDR has made the suggested revision throughout the document.

68. Page 61 PM This text is identical to text on page 47. Consider using it once and deleting the other instance.

Response:

Thank you for your suggestion, ATSDR has made the suggested revision in the document.

69. B. Environmental Contaminants *Surface Soil and Household Dust* Non-residential soils near mining sites and areas that are often flooded appear to have the highest level of contamination. Common use areas (CUAs) are public access areas such as beaches, parks, and campgrounds. The highest surface soil concentrations of lead appeared in CUAs east of Lake Coeur d'Alene. Most of the samples with concentrations higher than 1,000 ppm came from CUAs along the CdA River and the South Fork CdA River. *Specifically mention that the TCdA runs through most of these areas.*

Response:

The data ATSDR evaluated was summarized and in most cases did not list sampling locations specific enough to determine proximity to the TCdA.

70. No lead concentrations higher than 1,000 ppm were observed in CUAs along Lake Coeur d'Alene and only infrequently along the Spokane River. ***This is incorrect. Harrison Beach, and locations along the TCdA from Harrison to Chatcolet have concentrations higher than 1000ppm. (See references.)***

Response:

ATSDR did not receive data which indicated concentrations of lead above 1000 ppm as you have indicated. In addition, ATSDR was not able to locate the referenced letter to the US Corp of Engineers from McCulley, Frick and Gulman, Inc. dated 12/10/2001. If such information becomes available to ATSDR at a future date it will be reviewed and evaluated for potential public health implications if warranted.

71. ***Sediment*** **Sampling detected elevated metals concentrations in surface sediments in many areas. These areas range from mining sites near the headwaters of the tributaries to the South Fork CdA River to downstream stretches of the Spokane River.** ***Add areas along the TCdA in the lake south of Harrison, where there could be no additional source other than rail gondola spillage.***

Response:

While such contamination is likely, ATSDR did not receive sampling data for evaluation from this area of the CdA River Basin. If such data are made available they can be evaluated to determine if additional action is needed.

72. ***Ambient Air There is a risk of blowing dust during the high use dry season at certain areas with little vegetation through which the TCdA runs, notably near Page, Cataldo, and Springston. This is a major data gap.***

Response:

ATSDR has recognized air monitoring data as a data gap and has requested that such data be collected. If such data is made available, ATSDR can evaluate the data to see if its conclusions are impacted.

73. ***Other Completed Pathways Add blowing dust for reasons stated above.***

Response:

ATSDR does not currently have the data necessary to make such a determination.

74. F. Conclusions ***Current Exposures*** **Potential for exposure to metals while recreating on the TCdA is generally low. However, persons who are potentially exposed to metals in their normal living environment should stay on the trail to reduce risk of additional exposure to contaminants in media in close proximity to the trail.** ***Add exposure to blowing dust for reasons stated above.***

Response:

If contaminated soil is introduced into the living environment as dust it could potentially pose a hazard and precautions should be taken.

75. The data show that recreation at Lake Coeur d'Alene represents no apparent public health hazard. In arriving at this determination, ATSDR estimated exposure doses for acute and intermediate exposure durations for persons exposed to surface waters and sediments only during recreation. (e.g., water skiers, anglers). These estimated doses do not exceed levels known to cause adverse health effects. ***Mention the exception of Harrison Beach. It had clean fill dumped on it recently, but will recontaminate with normal sedimentation from the CdA River, and possibly from seepage from the immediately upslope UPRR causeway.***

Response:

ATSDR has addressed this issue, based upon available information, in the document.

76. Warnings have been posted regarding metals contamination and precautions have been taken to reduce risk of exposure to metals in the vicinity of the TCdA. ***These are insufficient.***

Response:

ATSDR recommends that efforts be maintained or strengthened. As ATSDR is not a regulatory agency, the extent of our authority is to recommend access restriction and posting. It will be up to the regulatory agencies to decide the type of restrictions they are willing to implement to protect public health. You may try informing your local government officials to see if there are additional actions which may be taken. ATSDR encourages compliance with warning signs to reduce unnecessary exposures.

77. Visitors who remain on the trail should not experience any increased adverse health effects from use of the TCdA. All users are advised to remain on the trail. If direct contact with contaminated soil does occur the exposed area should be washed. ***There are no washing facilities on the TCdA.***

Response:

ATSDR agrees that washing facilities would be nice to have along the trail. TCdA users should remain on the trail. If direct contact exposure to contaminated environmental media occurs, the exposed area should be washed as soon as possible.

78. G. Recommendations Increase the number of warning signs along the Trail of the Coeur d'Alenes and restrict access to areas with elevated metals

contamination. ***These are largely ignored. Recommend increased patrolling, fences, or closure in certain high risk segments.***

Response:

ATSDR has recommended increasing the number of warning signs. It will be up to the regulatory agencies to decide the type of restrictions they are willing to implement to protect public health. ATSDR will support additional actions if deemed warranted.

79. H. Public Health Action Plan ***Activities Ongoing and Planned*** **Further assess the impact of site contamination on area Native American tribes. If enough data become available, ATSDR will issue a separate document to evaluate the public health impact of the site on area tribes;** ***This should start with an accurate determination of where tribal members actually live, work, and play. We know of no tribal members living east of Lake Coeur d'Alene.***

Response:

If additional information is received that impacts the conclusions of this PHA, ATSDR will determine if additional actions are needed.

80. Work with CdA River Basin community to identify any additional environmental health concerns related to the site; ***The TCdA right-of-way was never tested for anything but lead once the EE/CA was completed. Our citizen testing showed anomalously high levels of arsenic, and large tie dumps existed in the lake with a petroleum sheen for decades.***

Response:

ATSDR makes its assessment and recommendations based upon sampling data received from EPA and other sources. ATSDR reviewed information provided by local citizen groups. However, the information provided was not quality assured and controlled data. If suitable data are made available to ATSDR for evaluation, ATSDR will determine if its conclusions regarding the site are significantly impacted and take appropriate action as necessary.

81. 2.1 Site Description and History Transport of contaminants from hillsides and tailings piles under the force of river flow and erosion, particularly during flood events, has also contributed to CdA River Basin contamination. The closure of most smelting operations in the Bunker Hill area in the 1980s diminished air emissions of metals considerably. Nevertheless, surface waters continue to carry trace amounts of tailings, contaminated sediments, and dissolved metals to areas west of the Box. As a result, virtually all soils located in the floodplain of the South Fork CdA River and CdA River are potentially contaminated. ***Add that a century of transportation and spillage of ore concentrate by rail cars extended the range of contamination.***

Response:

This source of contamination has been mentioned in section 2.1 of the PHA.

82. ***2.3.1. Demographics*** ***Add statistics on tribal members - how many, and where.***

Response:

ATSDR does not believe that statistics related to the location of Tribal members is relevant to this PHA. ATSDR is working with the Coeur d'Alene Tribe to address issues pertinent to the tribe's unique lifestyle and other factors. Once these issues are resolved specifics will be delineated in an appropriate format. ATSDR will include demographic information regarding the Tribe if the Tribe feels it is relevant and wants it included. ATSDR's concern is that Tribal members may go into contaminated areas, not necessarily where they live.

83. ***2.3.2. Land Use*** **Another section of the CdA River Basin is Tribal land.** ***Describe where this land is, and why it is "Tribal Land". The Tribal Trust land is in upland areas mostly west of the Lake.***

Response:

Figures of areas designated as the Reservation ("Tribal Land") has been included in documents produced by EPA including the EE/CA for the UPRR Wallace-Mullan Branch (figures 2 and 9). ATSDR is working with the Coeur d'Alene Tribe to address issues pertinent to the tribe's unique lifestyle. Once these issues are resolved specifics will be delineated in an appropriate format. ATSDR will include a delineated description of Tribal Lands if necessary to explain its findings.

84. ***3.1.1.3. Surface Soil from Common Use Areas*** **The CUA sampling suggests that the lead contamination in surface soil is highest in areas east of Lake Coeur d'Alene. Lead concentrations higher than 1,000 ppm were most frequently reported for CUAs along the CdA River and South Fork CdA River; no lead concentrations higher than this level were observed in CUAs along Lake Coeur d'Alene itself.** ***State the exceptions at Harrison, and the shore line along the TCdA at Cal's Pond.***

Response:

ATSDR has addressed the issue of past contamination at Harrison (namely Harrison Beach). ATSDR has not received data regarding concentrations of contaminants at a location identified officially as "Cal's Pond."

85. Another potential limitation is the sheer size of the area. Characterizing the precise extent of surface soil contamination for a region as large as the CdA River Basin is unrealistic. Thus, while ATSDR has reviewed the results of thousands of surface soil samples, quite possibly some areas of elevated

contamination have not yet been identified. ***Specifically mention the lack of testing of the lakeshore along the TCdA.***

Response:

Thank you for your comment. EPA is continuing to sample throughout the CdA River Basin site especially in light of the National Academy of Sciences report. If requested, ATSDR will review and evaluate any additional environmental sampling data and if possible, determine possible health implications. The results of such evaluations will be issued in the form of a public health consultation.

86. ***3.1.6. Terrestrial Biota Animals Check to new work by Audet et al at the USFWS***.

Response:

ATSDR has reviewed more recent publications and updated the bibliography section of the PHA.

87. 3.2. Data Gaps ***State no studies of blowing dust during times of high winds in the dry season in CUAs exist.***

Response:

This data gap has been added to the body text of the PHA in section 3.2. However, ATSDR did recommend monitoring of ambient air quality at locations where remedial and construction activities involve soil excavation or removal and employment of dust suppression techniques to minimize the release of dusts during remediation activities in previous drafts of the PHA.

88. ***4.2.3. Current Consumption of Water Potatoes Harvested in the CdA River Basin site*** **The Coeur d'Alene Tribe has reported that tribal members are aware of area contamination and are not currently consuming water potatoes from the contaminated sediments of the CdA River Basin.** ***Tribal members don't routinely travel over two hours from where they live to harvest water potatoes anyway. This section need not be included.***

Response:

Thank you for your comment. However, this section has been included in response to the need to address Tribal issues.

89. ***5.2.1. Exposure to Lead*** **Currently available information indicates that the number of children with high blood leads is decreasing. Opinions differ, however, regarding how representative the tested children are of all CdA River Basin children.** ***The most recent Pandhandle Health testing showed an INCREASE in the lower basin, although the numbers tested is such a small percentage. Recommend more widespread testing in the Lower Basin!***

Response:

ATSDR recommends more widespread testing throughout the CdA River Basin. ATSDR and CDC's National Center for Environmental Health (NCEH) will assist the Basin Environmental Project Improvement Commission, IDEQ, IDH, PHD, and EPA to plan an appropriate blood-lead monitoring program for young children in high risk areas for lead poisoning and other environmental contaminants. However, governmental agencies cannot force individuals to have their children tested, they can only recommend that testing occurs.

The ideal program would integrate a blood-lead monitoring program that strengthens the infrastructure and capacity of the area's overall remedial, housing, and public health activities. Examples of local partnerships may include the following programs: Women and Infant Care, MEDICAID (Early Period Screening, Diagnostic, and Treatment), Immunization, and Early Head Start.

90. Lead was also detected in the surface water, sediments, and surface soils of the Lake Coeur d'Alene area as well as in tap water samples from Harrison Beach. The estimated exposure doses are at least two orders of magnitude below the lowest-observed-adverse effect-level (LOAEL) for humans identified in Stuik, 1974. Because these exposures are short and intermittent, adverse non-cancer health effects are unlikely to occur. Similarly, ATSDR does not expect an increased risk of cancer from these exposures. ***Harrison Beach has frequent local resident use, and is prone to re-contamination.***

Response:

ATSDR recommends monitoring following flood events to see if recontamination has occurred.

91. ***5.2.2. Exposure to Arsenic East of the Box The TCdA UP testing did not include arsenic after the EE/CA***

Response:

Comment noted. However, warnings and actions given for lead would be appropriate for reducing arsenic exposures as well.

92. 8.3. Trail of the Coeur d'Alenes ATSDR is aware that many areas along the 73 miles of trail are not well signed or fenced, however. Leaving the TCdA and entering uncontrolled areas is of particular concern for local residents, especially children, who may already have lead and other exposures in their normal living environment. In particular, areas along the river west of the Box allow access to the contaminated sands of the river bank. The frequency of such exposures would probably be low, however, so the potential for health concern is generally low. ***These statements seem to contradict themselves. We feel there is the potential for frequent exposures.***

Response:

There is always a potential for exposure, however ATSDR does not believe that frequent exposure at concentrations and durations of health concern would occur. Although an individual may have residential exposure, ATSDR does not believe that a resident would willingly expose himself/herself to contaminated environmental media for such a duration as to have a significantly increased impact upon his/her health.

93. ATSDR believes that if people were to stay on the main portion of the TCdA itself, they should not experience any increased adverse health effects from use of the TCdA. Nonetheless, previous experience suggests that that the likelihood of all TCdA users remaining on the trail itself is quite low. Hikers and other users may venture into areas beyond the ROW which have not been cleaned up or otherwise remediated. Experience also suggests that people are likely to ignore warnings and use the TCdA to access local waters and scenic areas. ***We agree, and additional fencing or closing segments of the TCdA should be recommended.***

Response:

As ATSDR is not a regulatory agency, the extent of our authority is to recommend access restriction and posting. It will be up to the regulatory agencies to decide the type of restrictions they are willing to implement to protect public health.

94. Therefore, ATSDR emphasizes that TCdA users should remain on the trail. If direct contact exposure to contaminated media occurs, the exposed area should be washed. ***There are no washing facilities at oases on the trail.***

Response:

ATSDR agrees that it would be nice to have washing facilities along the TCdA. TCdA users should remain on the trail. If direct contact exposure to contaminated environmental media occurs, the exposed area should be washed as soon as possible.

95. ATSDR also recommends posting more signs along the 73-mile trail and its access points. ***And fencing, and closing segments.***

Response:

It will be up to the regulatory agencies to decide the type of restrictions they are willing to implement to protect public health. ATSDR recommends and supports other actions, as appropriate, if signs are not effective.

96. ***9.1.2. Exposures of Concern to Recreational Users with Residential Exposures Lake Coeur d'Alene*** **The data shows that, aside from the potential hazards from eating aquatic biota described below, recreating at Lake Coeur d'Alene**

represents no apparent public health hazard. ***State the exception of Harrison Beach and the TCdA south of Harrison.***

Response:

Based upon information contained in EPA documents, lead and arsenic at Harrison Beach have been remediated as part of a UPRR removal action. ATSDR had not reviewed any sampling data which indicates that individuals are being exposed to elevated concentrations of those metals at Harrison Beach. If Harrison Beach is re-contaminated, additional evaluation may be needed.

97. ATSDR does not expect negative health effects to result in individuals from recreational activities at CUAs within the Basin. ***Unless the individuals are also residents, and they are at Harrison Beach, or leaving the TCdA.***

Response:

ATSDR agrees that residents may have increased risk for adverse health effects. Based upon information contained in EPA documents, exposures to lead and arsenic at Harrison Beach have been remediated as part of a UPRR removal action. ATSDR had not reviewed any sampling data which indicates that individuals are being exposed to elevated concentrations of those metals at Harrison Beach.

98. In general, mercury is not thought to be a concern in the Basin. However, a public health hazard from mercury could exist for children under 15 years of age who eat more than 65 grams of Lake Coeur d'Alene fish per day. ***State the situation with Arsenic and Creosote along the TCdA.***

Response:

ATSDR believes that arsenic exposure scenarios have been dealt with appropriately in the PHA. ATSDR has not seen data regarding creosote concentrations along the TCdA and therefore could not make a recommendation regarding such exposures, if any.

99. 9.2. Past Site Conditions and Exposures ***State that the ore trains ran with great regularity for over a century, billowing toxic dust and slopping toxic slurry.***

Response:

This section of the document has be revised as follows:

Based upon sampling data, lead and other concentrates which spilled from ore transport trains have contributed to contamination of the adjacent right-of-way.

100. 9.4. Conclusions Based on Area Environmental Studies 3. No lead concentrations higher than 1,000 ppm were found in CUAs along Lake Coeur d'Alene…State the exceptions of Harrison Beach and the TCdA.

Response:

Based upon information contained in EPA's Record of Decision for OU3 (dated September 2002), Harrison Beach had elevated concentrations of lead and arsenic in soils and sediments and has been remediated as part of the UPRR removal action.

101. 10. RECOMMENDATIONS 4. Continue to make blood lead monitoring available to area children. Perform follow up as appropriate. ***This should be strengthened for the Lower Basin, with more publicity and inducements to have children tested.***

Response:

ATSDR agrees that blood lead monitoring should be increased throughout the CdA River Basin. ATSDR and CDC's National Center for Environmental Health (NCEH) will assist the Basin Environmental Project Improvement Commission, IDEQ, IDH, PHD, and EPA to plan an appropriate blood-lead monitoring program for young children in high risk areas for lead poisoning and other environmental contaminants.

The ideal program would integrate a blood-lead monitoring program that strengthens the infrastructure and capacity of the area's overall remedial, housing, and public health activities. Examples of local partnerships may include the following programs: Women and Infant Care, MEDICAID (Early Period Screening, Diagnostic, and Treatment), Immunization, and Early Head Start.

Your comments are appreciated, however, ATSDR believes the recommendation is sufficient as written.

102. 11. Signage along the 73-mile TCdA should be increased. Access to and from contaminated environmental media onto the trail should be restricted. ***The TCdA needs additional patrolling, fencing, and closure of segments where these actions do not control access.***

Response:

As ATSDR is not a regulatory agency, the extent of our authority is to recommend access restriction and posting. It will be up to the regulatory agencies to decide the type of restrictions they are willing to implement to protect public health. Should signage and access restriction fail to control exposures, ATSDR supports other precautions/public health actions that regulatory agencies may wish to impose.

103. 11. PUBLIC HEALTH ACTION PLAN 11.2. Actions Planned for the Site **1. ATSDR and CDC's National Center for Environmental Health (NCEH) will assist the Basin Environmental Project Improvement Commission, IDEQ, IDH, PHD, and EPA to plan an appropriate blood-lead monitoring program for**

young children in high risk areas for lead poisoning and other environmental contaminants. ***Be more proactive in the Lower Basin!***

Response:

ATSDR's recommendations are meant to protect all populations. Given that the potential for exposure to lead exists throughout the CdA River Basin there is no need to single out a particular residential population.

104. 4. ATSDR, upon request, will assess any other potential impact of site contamination on tribal areas. If requested and enough data becomes available, ATSDR will issue a separate document addressing those tribal issues. ***Please define what you mean by "tribal area".***

Response:

ATSDR is working with the Coeur d'Alene Tribe to address issues pertinent to the tribe's unique lifestyle. Once these issues are resolved specifics will be delineated in an appropriate format.

105. Ex Sum, pg 1, 7th para; The Tribe uses its Lake for other purposes including, traditional, and aesthetic uses.

Response:

This fact has been added to the PHA.

106. Ex Sum, pg 1, B 1st para; Mercury has been identified to be a metal of concern for fish consumption. Therefore, this should be added to ATSDR's list of environmental contaminants.

Response:

Thank you for your comment. ATSDR has corrected this oversight in the PHA.

107. Ex Sum, pg 2, 3rd full para; At certain times of the year nearly all of the flood-plain in the CDA River is used by humans, therefore, the Tribe would like ATSDR to include the total acres in the flood-plain of the CDA River which exceed 1000ppm (the action level for EPA human health concern). Furthermore, it would be appropriate to have a map which depicts lead levels in the flood-plain. The Tribe has this GIS coverage and would gladly share this data set with ATSDR.

Response:

During its initial review of site sampling data, ATSDR was not provided data which could be use to determine exact point locations for soil sample. ATSDR's contractors were told that this was due to privacy concerns. ATSDR has received the Tribe's GIS coverage data. The map has been included in the document as Figure 6.

108. Ex Sum, pg 3, under Surface Water; The Tribe believes that this paragraph is not true to the extent that although surface water may have improved in the last 30 years it still exceeds ALC and at times human health standards for lead. Zinc ALC are continually exceeded. Also ATSDR should refer to the testimony of Dr. Anne Maest (DOJ, NRDA Expert witness) wherein she explained that surface water in the River and lake have not markedly improved in the last 20 years, and that metals are being mobilized from lake bed sediments.

Response:

While conditions have improved in areas of direct human contact, the fact remains that as contaminated sediments continue to move downstream they will continue to impact downstream resources.

109. Ex Sum, Sediments, para 2; Please add that approx. 75 million tons of contaminated sediments exist in Lake CDA and as the river continues to move upstream sediments downstream this amount will greatly increase.

Response:

While conditions have improved in areas of direct human contact, the fact remains that large quantities of contamination resides at the bottom of Lake CdA and a change in lake conditions could increase mobilization of those contaminants in a way that would increase risk to unacceptable levels. This is a unique concern of the Tribe as it impacts upon their fisheries. ATSDR concurs with the National Academy of Sciences recommendations for further lake studies.

110. Ex Sum, Aquatic Biota, 1st para; Is "trace-levels" a term of art? The Tribe would prefer that either this term was defined or omitted from the text.

Response:

Thank you for your comment. The phrase has been omitted from the main body text of the PHA as warranted.

111. Ex Sum, Aquatic Biota, para 2; Please mention that this does not hold true for the Tribe who traditionally cooks and eats the entire fish. In addition, many residents along the CDA River can whole fish.

Response:

This information has been added to the document. However, based on results of sampling studies and the fish consumption advisory which was issued jointly by the Coeur d'Alene Tribe and the State of Idaho, if those practices involve the species of fish from Lake CdA which are included in the advisory; such practices should be curtailed or the number of fish meals consumed should be adjusted to meet the criteria set forth in the consumption advisory.

112. Ex Sum, pg 3, Terrestrial Biota, 1st para; Please replace "trace" with "elevated". In addition, please site the NRDA Water Potato Study conducted by

the Tribe and USFWS which outlined exposure of metals not only through eating skins of the potatoes, but exposure of metals due to the nature of the collection technique employed in gathering water potatoes. This also holds true for gathering other roots, herbs and other plants for tribal traditional uses. Another major problem with terrestrial biota includes the year-in, year-out lead poisoning of several species of water-fowl in the flood-plain of the CDA River.

Response:

Thank you for your comments. Adjustments have been made to the document as appropriate.

ATSDR acknowledges that contamination within the Basin and floodplains is having an adverse impact on natural resources in the area including water fowl and terrestrial biota. Such impacts make it inadvisable for Tribal members to practice a traditional subsistence lifestyle. ATSDR recommends that steps be taken to reduce/eliminate these adverse impacts.

113. Ex Sum, pg 5, D. Potential Exposure Pathways; Why is Lake CDA not included in the list of water-bodies considered potential exposure pathways? Also, why does ATSDR call the site "the CDA River Basin" instead of what EPA called it, "the CDA Basin?"

Response:

The oversight of not including area lakes has been rectified. ATSDR has also included the floodplains as potential exposure pathways.

During the years that ATSDR has been working on the site, the name of the site has changed several time as has the description/boundaries of the site. In documents reviewed by ATSDR, EPA has used both titles interchangeably when referring to the site.

114. Ex Sum, pg 5, F. Conclusion, para 1; Add Mercury to the list of metals of concern.

Response:

This contaminant of concern in aquatic biota has been added to the main body text of the document.

115. Ex Sum, pg 5, F. Conclusion, para 2; Not only does the nature of contamination vary but so does the nature of use of the resources which are contaminated. As Trustee for the welfare of the human health of the Tribal members it is therefore, incumbent of ATSDR to clearly identify all the Tribal uses and determine human risk to the Tribe's population based on their unique exposures to the contaminants.

Response:

Per request from the Tribe, ATSDR has evaluated the site based upon a total subsistence scenario. Through this evaluation ATSDR has determined that if a person were to utilize contaminated resources in a manner consistent with a subsistence lifestyle, that person would be at increased risk for adverse health effects from increased body burden of lead. These adverse effects could include but are not limited to: elevated blood lead levels leading to behavior and learning problems, kidney damage, hypertension, damage to the central nervous system, growth retardation, and anemia.

Although it is a desire of the Tribe, ATSDR is not aware of any Tribal members currently leading a total subsistence lifestyle.

116. Ex Sum, Page 6; As has been the case with many documents which have come before this one, information related to Lake Coeur d'Alene and/or the Tribe is not straight forward or is down played. First ATSDR states in bold that east of the Lake "is" a public health hazard. Then it states in bold that west of the Lake is not an apparent public health hazard. Then it buries in the next 4 paragraphs that people who eat fish from the Lake are exposed to metal and those that eat a lot and have other pathways of exposure are at risk. So why then is there not a bold face statement that the Lake is a public health risk? Instead ATSDR plays a political game where once again the problem with the Lake and tribal uses of the lake are downplayed because ATSDR looked at visitor risk on the Lake and determined in bold print there is no apparent public health risk. This hide the pea under the shell game is unacceptable and transparent. The Tribe believes each scenario for the Lake should be uniformly evaluated and the conclusion clearly outlined.

Response:

The use of ATSDR's public health conclusion categories as a risk communication tool is currently under debate, therefore the bold face will be removed from the statements. ATSDR will indicate in the document that the fish advisory indicates that a public health hazard exist under certain scenarios for use of the lake, in particular those dealing with consumption of certain fish species. Under the current situation, recreational use of the lake by visitors represents no apparent public health hazard. However large quantities of contamination reside at the bottom of the lake and as conditions within the lake change the potential for mobilization of the contaminants increases which could result in adverse impacts upon a variety of exposure pathways.

Issues from a Tribal perspective regarding subsistence and natural resource use within the Basin (including floodplains) have not been included in the current remedies nor fully assessed.

117. Ex Sum, Pg 6, last paragraph; Once again recreational exposure was the basis in which ATSDR made this final declaration about the Lake. The Tribe was the aboriginal people which resided on the lake and in the basin. The Tribe still resides in its homeland and conducts traditional activities which present long-term, if not persistent exposure to contaminants. Although the Tribe has explained these issues time and time again to EPA during their HHRA these issues seem to have been minimized, if not completely left out of this ATSDR evaluation.

Response:

Using parameters outlined in EPA's HHRA, ATSDR evaluated the potential for exposure to and potential adverse effects resulting from living a subsistence lifestyle within the CdA River Basin. Based on this evaluation, ATSDR had concluded that if a person were to utilize contaminated resources in a manner consistent with a subsistence lifestyle, that person would be at increased risk for adverse health effects from increased body burden of lead. These adverse effects could include but are not limited to: elevated blood lead levels leading to behavior and learning problems, kidney damage, hypertension, damage to the central nervous system, growth retardation, and anemia. Modifications have been made to the main body of this document.

ATSDR has stated in the document that traditional subsistence tribal use is a desire of the CdA Tribe however given the current conditions within the CdA River Basin such a lifestyle will subject practitioners to unacceptable increased risk of adverse health impacts. Therefore traditional subsistence use of resources within the Basin are advised against due to the risk presented.

118. Ex Sum, Pg. 8, G. Recommendations; After reading these recommendations the Tribe is left with hopeless feeling. As it stands in this draft report, our federal trustee (ATSDR) who is responsible for the health and welfare of the Tribal people, and to uphold the purposes of the Tribe's reservation, has sold us out and suggests we live a diminished traditional lifestyle and a future which abounds with pollution and health warning signs and does little to nothing to fix the problem. This is unacceptable and has been the reason the Tribe filed the NRDA back in 1991. The Tribe is not interested in how to minimize risk (unless it is in the short-term) unless a permanent solution is in the making.

Response:

ATSDR appreciates the sentiments of the Tribe, however, ATSDR is a non-regulatory agency. ATSDR makes recommendations that address issues of human health significance to regulatory agencies, however, ATSDR leaves the method of addressing the issue to the regulatory agency involved.

In assessing exposures for the CdA River Basin site, ATSDR looked at three basic groups, long-term residents who also recreate in the area, workers, and persons who are in the area for short periods of time (recreational users). Until more specific information is made available to ATSDR regarding the Tribe's traditional (subsistence) lifestyle, ATSDR recommends Tribal members follow the recommendations and guidelines set forth for long-term residents until a permanent solution is developed.

The contamination problems within the CdA River Basin accumulated over a long period of time. It is unrealistic to believe that the problems can be addressed and the area converted back to pristine condition in a relatively short time period. Modifications in lifestyle are often necessary to maintain optimum health.

119. Ex Sum, 4th to last bullet; The bullet which talks about the fish advisory should include the Tribe as one of two issuing governments.

Response:

This oversight has been corrected in the document.

120. Ex Sum, pg 8, bottom of the page 1st bullet; This is the only sentence that has made any sense. Based on the lack of information which seems to be available to the ATSDR, the Tribe formally requests that additional studies be initiated immediately. In an effort to initiate this work effort the Tribe recently met with ATSDR to discuss how best to proceed. In addition, among many topics discussed a focus of the talk surrounded the Tribe disapproval of ATSDR moving forward with this document until Tribal issues are fully addressed and resolved. Based on our meeting with ATSDR the Tribe was promised detailed consultation with Tribal representatives in the revision of this report and the review of the subsequent next draft report. We look forward to this consultation and the further resolution of our issues.

Response:

ATSDR and representatives of the Tribe have worked together on this current revision of the document. ATSDR concurs with the Tribe in that further studies are needed to fully assess the impact of CdA River Basin contamination upon the health of the Tribe and its desire to return to a traditional subsistence lifestyle.

121. Page 10, 4th para; Understanding that the executive summary suggested that Tribal exposures were not fully addressed, other possible exposures could be medicinal and eatable roots, tubers, and plants. In an NRDA study on water potatoes in the Coeur d'Alene Basin (Audet et al., 1997) it was determined that although the tuber tissue did not uptake significant levels which could cause a health threat, the skin of the tuber and the sediment attached to the outer portion of the tuber did contain significant lead, and other metals, concentrations.

Response:

ATSDR is aware that the CdA Tribe would like the option of being able to eat the skin of locally grown water potatoes. However it is always possible for some sediment to remain attached to the skin of washed potatoes. If people were to eat the skin of the locally grown potatoes an unacceptable increased risk could be posed. It is suggested that locally grown water potatoes not be consumed until local contamination has been remediated.

122. Page 10, 6th para, first sentence; The Tribe believes that a significant body of available information has not been reviewed in the preparation of this report. Examples include all the NRDA related reports, the Spokane Tribe's Multi-pathway Subsistence Exposure Scenario and Screening Level RME (Harper et. al. 2002), among others.

Response:

ATSDR did review the Spokane Tribe's Multi-pathway Subsistence Exposure Scenario several years ago. Other documents were also reviewed several years ago. Since then this document has gone through many revisions and some of the references to the reviewed outside materials were removed for one reason or another. ATSDR has re-introduced those references found to be relevant into the document.

123. Page 11, 5th para, last sentence; Include the characterization of lake Coeur d'Alene bed sediments in this description of the extent of contamination.

Response:

ATSDR has added the fact that the sediments of Lake CdA are contaminated and that those contaminants could possibly reenter the water column under the right conditions. Also bottom feeding biota could ingest the contaminated sediments and concentrate the contaminants within their body.

124. Page 12, 7h para, last sentence; Based on the inadequate way ATSDR has addressed tribal concerns we believe that ATSDR must not have held any meeting on the Coeur d'Alene Tribe's Reservation. Is this correct?

Response:

Since the public comment version of the PHA was released, ATSDR has met with representatives of the CdA Tribe and other community members and citizens' groups. We have addressed the Tribe's concerns to the extent currently possible.

125. Page 13, Demographics; This section should contain information on those that reside along the Coeur d'Alene River, and Lake Coeur d'Alene. It should also include the demographics of the Coeur d'Alene Tribe, a people those reservation was specifically created with the purpose and intent of providing safe natural resources for their cultural and subsistence. In addition, as mentioned above, this section should also address predicted future demographics.

Response:

The demographic information contained in this current version of the document includes those residents who reside along the CdA River and Lake CdA, however this information has not been specifically broken down in such a manner.

126. Page 13 and 14, 2.3.3; Once again the Tribes use (or where the resources are polluted, lack of use) is not mentioned. In contaminated areas of the basin the Tribe has a moratorium on using the river basin vegetation, fish, and water resources. This moratorium is not the solution to the problem, instead it is a management tool to reduce the potential risk to Tribal members while the remediation is yet complete.

Response:

ATSDR stresses that living a subsistence lifestyle under the current conditions would place Tribal members at increased risk until remediation is affected.

127. Page 15, 3.1.; Mercury should be included since it is a chemical identified in the fish advisory.

Response:

This information has been added to the main body text.

128. Page 16, top of the page; Why has ATSDR omitted the lower basin flood-plains (the largest area of contaminated sediments)?

Response:

ATSDR did not intentionally omit the floodplains and has added a bullet indicating the floodplains as a possible source of soil contamination in this document. The floodplains are included in the sediments discussions in section 3.1.4.

129. Page 17, 2nd para; The Tribe and the NRDA trustees and EPA has a GIS coverage of lead concentrations throughout the flood-plain of the lower CDA Basin. Please contact Mr. Frank Roberts (Tribal GIS Program Manager) if you care to review this information.

Response:

ATSDR has included this information as Figure 6 in this document.

130. Page 17, Section 3.1.2. first set of bullets; Some residents use lake water for drinking water. Please add this source in the bullets.

Response:

In developing the PHA, ATSDR considered all available environmental data. ATSDR did not receive data indicating that some residents use the lake waters for drinking water. If appropriate documentation is provided, ATSDR will add lake water as a source of potable water within the CdA River Basin site. Given the concentrations of contaminants within Basin water-bodies ATSDR cautions against the use of water from unregulated or untreated sources.

131. Page 19, Section 3.1.3; Please review Ridolfi 1998 (Surface Waters) for more information related to the nature and extent of surface contamination.

Response:

The surface water within the Basin is definitely contaminated. Including this study will not change ATSDR's health call regarding this medium.

132. Page 20, 1st para; Lake Coeur d'Alene is also a source of drinking water. During the 1996 flood event this water has also exceeded drinking water standards for lead. Why is this not included in the report?

Response:

In developing the PHA, ATSDR considered all available environmental data. ATSDR did not receive data indicating that some residents use the lake waters for drinking water. If appropriate documentation is provided, ATSDR will add lake water as a source of potable water within the CdA River Basin site.

133. Page 20, Section 3.1.4. first para; Benthic flux of metals from the sediment into the water column has also been studied (Kuwabara and Ballisteri, 2002). This fact must be mentioned as a potential future risk of metals input into the water column of Lake CDA.

Response:

ATSDR has changed this document to state that large quantities of contamination reside at the bottom of Lake CdA and a change in lake conditions could increase mobilization in such a way that risk of adverse human health impacts would likely increase in one or more human exposure pathways.

134. Also, once again Lake Coeur d'Alene has not been included in the discussion of sediment contamination when an estimated 75 million tons of contaminated sediments exist in the bottom of the lake. In essence the lake is the basins largest repository of toxic metals. Given this data (USGS Horowitz 1991, EPA RI/FS 2001) it is difficult to understand how ATSDR could not include this fact in their report.

Response:

This information has been added to section 3.1.4 of the PHA.

135. Page 23, first para, last sentence; Where did the information on Tribal use come from. The Coeur d'Alene Tribe believes an in-depth study is needed to truly quantify Tribal uses of the resources.

Response:

The information came from the ATSDR Division of Health Studies Environmental Health Assessment (ATSDR 2000b) and data provided in the URS database ATDR received from EPA.

136. Page 23, Water Potatoes; It should be also noted that the gathering of these potatoes entails substantial exposure to humans from flood-plain sediments. It should also be noted that the non-use of water potatoes in the contaminated river flood-plain represents a major loss of a food resource for the Tribe an others who gather this plant.

Response:

For those individuals who desire to return to the traditional subsistence lifestyle and consume foodstuffs grown within natural Basin resource, such a lifestyle is currently unadvisable due to current levels of contamination within the CdA River Basin. As a result of contamination within the Basin, the Tribe has a moratorium on the use of plants within the CdA River corridor due to the high concentrations of metals in soils.

137. Page 25, Air; It should be noted that periodic wind storms can create isolated dust devils over "slickens" areas (areas denuded of vegetation due to high metals concentration in the soil) which could pose short-term health concerns. This usually occurs in the CDA River flood-plain and Cataldo flats, during the summer and fall.

Response:

ATSDR has included a statement noting that dust devils are reported to occur. Such an occurrence would re-entrain contaminated dust particles.

138. Page 26, numbered elements of exposure; Should not the amount of exposure (time or amount consumed) be considered as well.

Response:

This information is taken from ATSDR's guidance manual for public health assessments. The amount of exposure (time and amount consumed) is considered in exposure dose calculations. This is discussed in the Toxicological Evaluations section and Appendix D of this document.

139. Page 28, Ingestion of lead, 1st para; What would ATSDR do if the safe lead level is reduce below 10ug/l?

Response:

That would not change ATSDR's conclusion that the site is a public health hazard.

140. Page 32, Section 4.1.5; This section should have a sections specific to Tribal uses.

Response:

Based upon information currently at its disposal, ATSDR believes that current residential scenarios cover Tribal exposures.

141. Page 35, Section 4.2.3; Although the Tribe has adopted this moratorium, this is unacceptable to consider this loss as permanent.

Response:

For those individuals who desire to practice the traditional subsistence lifestyle and consume foodstuffs grown within natural Basin resource including fish, such a lifestyle is currently unadvisable due to current levels of contamination within the Basin. ATSDR has included statements that as a result of contamination the Tribe has a moratorium on the use of plants with the CdA River corridor due to the high concentrations of metals in the soils.

142. Page 42, last para; The Spokane Tribe and Washington DOE is currently conducting a fish tissue study to determine metals and PCB concentrations in fish flesh and organs. Until this work is complete ATSDR should caveat their opinion.

Response:

ATSDR has revised the paragraph to read "On the basis of fish and shellfish samples from the Spokane River to date and relevant exposure estimates…".

143. Page 43, Section 5.2.2; This sentence is in the past tense. Should this sentence not read could have and continues to be?

Response:

ATSDR has revised the paragraph to read: "People residing in and conducting recreational activities in various areas of the CdA River Basin could have been and continue to be exposed to arsenic in surface soils, surface water, sediments, and possibly groundwater..

144. Page 51, Section 5.2.7; Fish collected as part of the Coeur d'Alene Lake fish study are suppose to be evaluated for PCB's. The State of Idaho is responsible for this task. This data should be added to the final version of this document.

Response:

ATSDR noted in its Lake CdA fish sampling public health consultation that as part of the fish advisory issued by Idaho Division of Health, the fish samples collected in 2002 would be analyzed for PCBs. However, ATSDR has not received data from such an analysis. If requested, ATSDR will review the study and issue an opinion.

145. Page 67, Section 9.1.1.; Once again, the Lake has been omitted from ATSDR's evaluation. Given that there is a fish advisory, lead level have, and can exceed drinking water standards, and the fact that 75 million tons of contaminated sediments reside in lake bed sediments, the Tribe would suggest that health risk exist in the Lake.

Response:

ATSDR has added to the 3rd paragraph: "In addition, bed sediments within Lake CdA are contaminated with high concentrations of metals which can become suspended and cause surface water contamination which could further impact exposure pathways."

146. Page 69, Fish; 540 grams/day may not be appropriate. A detailed study is required to resolve this issue. See Harper, et. Al., 2002, mentioned earlier in this comment document for more appropriate consumption rates. In addition, the Avista relicencing process is developing extensive data on cultural uses in the Basin. This information should be reviewed and used as appropriate in finalizing this document.

Response:

ATSDR has indicated that those who eat greater amounts will experience greater risk.

147. In addition, this section provides risk information for residents and recreationalists, however, this section also needs a subsection on Tribal subsistence uses associated with the Lake.

Response:

ATSDR has revised the paragraph to read: "…Worst-case exposures used maximum metal levels and subsistence fish consumption…a public health hazard may exist for subsistence fish consumers. For those eating more than 540 g/day the risk increases proportionally."

148. In conclusion, government to government consultation between ATSDR and the Tribe is required during the development and prior to the finalization of this document. Although minimal talks have occurred to date, ATSDR has promised consultation will be accelerated from now until the completion of the document. Upon receipt of these comments the Tribe hopes ATSDR will seriously consider the content of our concerns and begin in earnest detailed discussions with Tribal staff and Council to address our concerns.

Response:

ATSDR appreciates the Tribe's comments on the public comment release PHA and its input into this final release document. ATSDR looks forward to future collaborations with the Tribe on CdA River Basin issues of relevance to the Tribe.

Appendix G–ATSDR Plain Language Glossary of Environmental Terms

ATSDR Glossary of Environmental Health 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).

Absorption
The process of taking in. For a person or 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]**.

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect]**.

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.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

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 indicators of exposure study
A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

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

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

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.

CAP
See **Community Assistance Panel**.

Cancer
Any one of a group of diseases that occurs 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.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

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 (more than 1 year) [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**].

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.
Community Assistance Panel (CAP)
A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

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.

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.

Delayed health effect
A disease or injury that happens as a result of exposures that might have occurred in the past.

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**].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

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
United States Department of Defense.

DOE
United States Department of Energy.

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.

Epidemiologic 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.

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-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

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 get 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**.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

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, and what methods 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.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

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

Half-life ($t_{½}$)
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 to reduce these 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 estimate 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**].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

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.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

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/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
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**].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

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

Mutagen
A substance that causes **mutations** (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

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]**

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

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**].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

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

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 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 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 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 environment.

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

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.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

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.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended 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 **epidemiologic 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**].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

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).

ug/l
Microgram per liter

ug/m^3
Microgram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

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.nlm.nih.gov/medlineplus/mplusdictionary.html

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

Appendix H–Fact Sheets

ATSDR Public Health Hazard Categories

Depending on the specific properties of the contaminant, the exposure situations, and the health status of individuals, a **public health hazard** may occur. Using data from public health assessments, sites are classified using one of the following public health hazard categories.

Category 1: Urgent Public Health Hazard

Sites that pose a serious risk to the public's health as the result of short-term exposures to hazardous substances.

Category 2: Public Health Hazard

Sites that pose a public health hazards as the result of long-term exposures to hazardous substances.

Category 3: Potential/Indeterminate Public Health Hazard

Sites for which no conclusions about public health hazard can be made because data are lacking.

Category 4: No Apparent Public Health Hazard

Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.

Category 5: No Public Health Hazard

Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

Appendix I–Supplemental Documents

List of Supplemental Documents

Health Consultation – Evaluation of Metals in Bullhead, Bass, and Kokanee from Lake Coeur d'Alene. September 19, 2003.
http://www.atsdr.cdc.gov/HAC/pha/coeurdalene/cda_toc.html

Summary Report – Summary Report for the ATSDR Soil-Pica Workshop. June 2000 Atlanta, Georgia. March 20, 2001.
http://www.atsdr.cdc.gov/NEWS/soilpica.html

Health Study – Coeur d'Alene River Basin Environmental Health Assessment. August 2000.
http://www.healthandwelfare.idaho.gov/Portals/_Rainbow/Documents/Health/cdaRiverBasinExposureSummaryReport.pdf

Health Consultation – Coeur d'Alene River Basin/Common Use Areas (a/k/a Spokane River – Washington State Common Use Area Sediment Characterization). April 26, 2006.
http://www.atsdr.cdc.gov/HAC/pha/CoeurdAleneBasin/Coeurd'AleneBasinHC042606.pdf

Health Consultation – Basin-Wide Residential Properties sampled under Field Sampling Plan Addendum 06 (FSPA06). May 16, 2000.
http://www.atsdr.cdc.gov/HAC/pha/basinres/bas_toc.html

Health Consultation – Coeur d'Alene River Basin/Common Use Areas (a/k/a Coeur d'Alene River Basin Panhandle Region of Idaho). April 13, 2000.
http://www.atsdr.cdc.gov/HAC/pha/coe/coe_toc.html