Health Consultation

EVALUATION OF LEAD IN SOIL

GILMORE MINE AREA AND TOWNSITE

GILMORE, LEMHI COUNTY, IDAHO

EPA FACILITY ID: IDN001002156

JUNE 26, 2023

Prepared by the

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Community Health Hazard Assessment
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. To prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting the use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Acronyms and Abbreviations

ACCLPP	Advisory Committee on Childhood Lead Poisoning Prevention
ALM	Adult lead methodology
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	All-terrain vehicle
BLM	Bureau of Land Management
BLRV	Blood lead reference value
C	central
CDC	Centers for Disease Control and Prevention
d	day
E&E	Ecology and Environment, Inc.
EIPH	Eastern Idaho Public Health
EPA	Environmental Protection Agency
IARC	International Agency for Research on Cancer
ICPMS	Inductively coupled plasma mass spectrometry
ID	Idaho
IDEQ	Idaho Department of Environmental Quality
IDHW	Idaho Department of Health and Welfare
IDL	Idaho Department of Lands
IEUBK	Integrated exposure uptake biokinetic (model)
ISHS	Idaho State Historical Society
ISM	Incremental sampling methodology
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
Mg/L	milligrams per liter
MLLC	Meadow Lake Land Company
mph	Miles per hour
NAAQS	National ambient air quality standard
NHANES	National Health and Nutrition Examination Survey
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
NE	northeast
NW	northwest
RSL	Regional screening level
S	south
SE	southeast
SoilSHOP	Soil screening, health, outreach and partnership
SW	southwest
µg/dL	Microgram per deciliter
µg/L	Microgram per liter

µg/m^3	Microgram per cubic meter
USFS	U.S. Forest Service
USPSTF	U.S. Preventive Services Task Force
wk	week
XRF	X-ray fluorescence
95UCL	95 percent upper confidence limit of the mean

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10. Adult estimated average (geometric mean) blood lead level and probability that fetal blood is greater than target blood lead level of concern using time-weighted soil concentrations when applicable, Gilmore, Idaho.

1. Summary

The Gilmore townsite, located in Lemhi County, Idaho, sits at the base of a multi-mine complex that was historically active periodically from the early 1880s through the late 1930s. The mine produced mostly lead and zinc, and some gold. Waste piles (tailings) from historical mining remain near mine openings. Mining areas and some townsite soils contain elevated levels of lead and other metals from the mines. In the townsite, contamination is highest in the northern portion, where open ore cars moved raw or processed ore along tramway and railway transportation structures.

In recent years the townsite has been gaining popularity as a recreational destination where visitors own land and come back to the same parcel multiple times during a six-month window from late spring to early fall. Approximately six dwellings are inhabited year-round. Health and environmental agencies are concerned that site users are at risk of health effects from exposure to heavy metals from mining activities, especially lead. Additionally, Shoshone-Bannock tribal members frequent this area on their way to gather, hunt, fish, and collect medicinal plants and soil, as part of their traditional range.

In July 2021, the Idaho Department of Health and Welfare (IDHW) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) complete an evaluation of metals in soil, water, and dust in residential and recreational areas around Gilmore. ATSDR found that there was sufficient information about lead levels in soil at the townsite to evaluate health risks from accidentally consuming the soil. A comprehensive evaluation of the data from other heavy metals, such as arsenic, remains to be completed by ATSDR. ATSDR made the following conclusions:

Conclusion #1	**Children and adults residing or visiting the townsite multiple times may accidentally ingest lead-contaminated soil at levels that could harm their health. Pregnant women who visit the site multiple times may ingest lead-contaminated soil at levels that could harm their fetus**. ATSDR considers this situation a past and present public health hazard. ATSDR is not aware of any current or planned primary intervention to reduce lead exposure at the site. Until lead exposures are mitigated, the site will continue to pose a public health hazard into the future.
Basis for Decision	Children may be repeatedly exposed to levels of surface soil lead in most of the townsite that can harm health. There is no safe level of blood lead. Estimated blood lead levels from staying at the townsite

just once a week during the summer months (~13 days) in many areas of the townsite may lead to an exposure that may harm health.

Although most children have no obvious immediate symptoms of lead poisoning, lead can affect almost every organ and system in the body. The nervous system is the main target for lead exposure. At lower levels of exposure, lead can decrease mental development, especially learning, intelligence, and behavior. Physical growth may also be decreased. Children are more vulnerable to lead poisoning than adults because their nervous system is still developing. Some effects that occur in a child may continue into adulthood. Other effects can occur at higher blood lead levels. Blood lead levels in some children exposed to higher soil lead levels at the townsite should be monitored by a physician.

At most areas of the townsite, adults may be repeatedly exposed to levels of surface soil lead that can harm health. Estimated blood lead levels from staying at the northern portion of the townsite (north of Zinc Street) twice a week during the summer months (~26 days) may lead to an exposure that may harm health. Longer exposure durations may be of concern in other parts of town (between Gold and Lead Street). Drinking water with soil in it during traditional practices may result in higher exposures to tribal members than described through incidental ingestion.

Like in children, the nervous system is the main target for lead poisoning in adults. In adults, long-term exposure can result in decreased learning, memory, attention, and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia and damage to the kidneys. It can also increase blood pressure, particularly in middle-aged and older individuals. In pregnant women, exposure to high levels of lead may cause a miscarriage. The lead body burden of the mother may be transferred to a fetus in the womb, resulting in health effects to the fetus (see above).

Conclusion #2	**People who work, dig, or excavate soil in the mining area or townsite on a regular basis may accidentally swallow more soil and dust than other people. This may lead to blood lead levels of great concern**, especially in the mining areas or in the townsite north of Zinc Street.
Basis for Decision	The levels of lead on waste piles at Gilmore are very high; some areas have over 40,000 mg/kg (also referred to as parts per million).

	Actively moving or digging in the piles may result in a one-time high exposure that may result in acute effects and add to the overall body burden. In pregnant workers, exposure to high levels of lead may cause a miscarriage. In men it can cause damage to reproductive organs.
Conclusion #3	**ATSDR does not have enough information to determine how much lead-contaminated dust particles in ambient air contribute to lead exposure over time**. We do not know how much lead is in dust that people breathe when participating in recreational activities, such as riding all-terrain vehicles (ATVs) in contaminated areas. More information is needed about the frequency and duration of lead levels in the air over time.
Basis for Decision	EPA collected air samples that had lead-contaminated particles at levels of health concern, but we don't know how lead concentrations in ambient air dust vary during the year. Given the windy nature of the area and the fine dust found on the roads and hillside, it may be possible that dust is being resuspended. Inhaled lead-contaminated dust particles can be accidentally swallowed or absorbed into the bloodstream from the lungs. More sampling over time would allow us to better understand the health risk from lead on dust in the air. Exposure during recreational or construction activities that create dust in the air such as hiking, bike riding, riding ATVs, riding horses, or excavating/digging soil may increase swallowing or breathing lead-contaminated soil or dust, thus increasing harm to health. We do not have any information about the levels of lead in the dust that is created from these dust-generating activities on the roads or the lands surrounding the townsite. Activity-based sampling is one way we can start to understand the contribution these activities may have on exposure. Activity-based sampling has shown that activities such as ATV riding may result in exposures of health concern from dust or associated contaminants [Newfields 2003; ATSDR 2007].
Conclusion #4	**Adults or children visiting or playing around abandoned mine shafts are at risk for physical harm and may be exposed to harmful contaminants**.
Basis for Decision	The Idaho Department of Lands (IDL) has closed mine adits in the mining district on private property where owners have granted

access [IDL 2020]. However, an unknown number of mine adits remain open, particularly on private property. These may be unstable and collapse. The Bureau of Land Management (BLM) reports that the leading cause of death at abandoned mines is drowning in water-filled pits and quarries, while the second most common cause of death and injury is falling into vertical underground mine openings. Lethal gases (methane, carbon monoxide, hydrogen sulfide, and toxic levels of carbon dioxide) can accumulate in underground passages—even close to entrances. People can also be exposed to radioactive gases and low-oxygen environments at abandoned mines [BLM 2023].

1.1. Next Steps

For environmental agencies:

1. ATSDR recommends that EPA and IDEQ rapidly assess the area to determine where people (especially children or pregnant women) may contact soil and take actions to reduce exposures to high levels of lead in soil (primary intervention). EPA and IDEQ should also consider options to reduce exposures to fugitive dust from lead-contaminated roads and source pile areas.
2. ATSDR recommends that IDEQ and EPA, in collaboration with IDHW, assess the frequency and duration of people staying in the Gilmore area, as well as their site use activities. This will enhance the ability of health agencies to quantify health risks more accurately and help environmental agencies identify the most effective mitigation strategies to reduce harmful exposures.
3. ATSDR recommends that IDEQ and/or EPA conduct additional assessments to characterize the extent of contamination in and around the Gilmore townsite, including exposure that occurs during recreational activities.
4. ATSDR recommends that IDL and BLM continue to mitigate physical hazards around mine openings in cooperation with private landowners.

For people residing at or visiting the site:

1. ATSDR recommends that pregnant women and parents/guardians of young children who regularly visit the site talk with a physician about this exposure and consider blood lead screening.
2. ATSDR recommends that adults actively working, excavating, digging in soil, or staying at the site on average 2 days per week or more north of Zinc Street should talk with a physician about this exposure and consider blood lead screening.
3. ATSDR recommends behaviors that can reduce exposure (see State of Idaho fact sheet, Appendix C). Avoid breathing in dust when riding ATVs, bike riding, or driving with the windows down. Options to decrease the inhalation of dust include driving more slowly, wearing a mask, and increasing your distance from other vehicles you are following.
4. ATSDR recommends that the Shoshone-Bannock Tribes advise members not to mix soil from the Gilmore mine areas or townsite with water for drinking during traditional practices.

For health agencies:

1. ATSDR recommends that IDHW develop and implement a communication and outreach plan in collaboration with IDEQ, the

U.S. Forest Service (USFS), BLM, EPA, and Eastern Idaho Public Health (EIPH) to expand on outreach activities to date. The plan should identify and implement long-term, evidence-based strategies to reduce exposure to lead and a process to evaluate the effectiveness of interventions.

2. ATSDR recommends that IDHW complete a comprehensive public health assessment evaluating the intermediate and long-term exposures and pathways of contaminants measured in the mine area and townsite when additional data are available.

Public Health Action Plan:

ATSDR will disseminate and discuss findings of this health consultation with townsite property owners, with local, state, and federal health and environmental officials, and with other interested stakeholders.

ATSDR will continue to provide public health-related technical assistance to IDEQ and EPA as they further investigate the site and develop site removal, remedial, or risk mitigation strategies.

ATSDR and IDHW will work with state health and EIPH to educate health care providers and parents, and they will encourage blood lead testing of children who visit the site.

IDEQ will coordinate activities with IDHW, ATSDR, and EPA to better understand the community living and visiting the Gilmore area, the frequency of their stays, and activities that may result in lead exposures.

IDHW will develop and implement a site-specific communication and outreach plan.

IDHW will evaluate remaining site-related contaminants and exposure pathways as data become available, and share findings in published reports.

1.2. For More Information

For more information, please contact Rhonda Kaetzel at vnc2@cdc.gov or 206-471-2443, or Lori Verbrugge at guk7@cdc.gov or 907-538-2850.

2. Background

2.1. Statement of Issue and Purpose

The Gilmore townsite sits at the base of a multi-mine complex that was historically active off and on from the early 1880s through the late 1930s. Mines in the district primarily produced lead and silver. Parts of the townsite historically housed workers, while other areas were influenced by an above-ground tramway where processed ore was loaded onto railcars. Waste piles (tailings) from historical mining remain near the site, and some townsite soil contains elevated levels of lead and other metals from the mines. In recent years the townsite has been gaining popularity as a recreational destination. The townsite has been divided up into smaller parcels and sold to private individuals. Health and environmental agencies are concerned that site users are at risk of health effects from mine contaminants, especially lead.

Idaho Department of Environmental Quality (IDEQ) and the Environmental Protection Agency (EPA) have been characterizing levels of metals in the mining areas, townsite, and ambient air since 2016. In July 2021, the Idaho Department of Health and Welfare (IDHW) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) complete an evaluation of metals in soil, water, and dust in residential and recreational areas around the Gilmore Division of the Texas Mining District in Lemhi County, Idaho. Subsequently, ATSDR has been working with IDEQ, EPA, and IDHW on outreach and met via phone with the Idaho Department of Environmental Quality (IDEQ) and the Environmental Protection Agency (EPA) who both also requested public health input on the health risks of metals in the soil, air, and water to residents, temporary residents, and visitors to the Gilmore townsite.

2.2. Site description and timeline

Gilmore Mining Area. The Gilmore Division of the Texas Mining District in Lemhi County (Figure 1) was active off and on from the early 1880s through the late 1930s [IDEQ 2010; IDEQ 2011, IDEQ/TerraGraphics 2017, E&E 2017]. The mining area had up to 60 patented mine claims, with six major mines. Mines in this district produced primarily lead and silver, along with small amounts of gold, copper, and zinc. Historical records suggest that Gilmore did not have a smelter; ore was either processed on site or shipped out for processing [ISHS 1976]. To process ore containing gold, a steam powered jig and mill plant was constructed at the Pittsburgh-Idaho Mine (known locally as the Gilmore Mine) and a ball mill was installed at the Martha (Allie)

Mine [Mitchell 1997]. The processed ore was carried by a transportation tunnel connecting the underground workings to an above-ground tramway where it was loaded onto railcars in the Gilmore townsite from 1910 to 1939 (Figure 2).

In the early 1950s, a large portable mill was brought in to crush and reprocess waste rock that was not high-grade ore [Moll and Moll, ND], but further details on this operation were not found. Currently, four large piles and one small pile of mine waste materials (tailings and waste rock) are west and uphill from the townsite. Areas of discolored soil are present between these piles and the railroad loading area within the northern part of the current day townsite (Figure 2). The tailings have not been treated or covered; some owners erected fences around the waste piles to prevent access. The Bureau of Land Management (BLM), U.S. Forest Service (USFS), and private entities have land in the areas surrounding the Gilmore townsite [E&E 2017, BLM 2022, IDEQ/Alta 2022]. The Idaho Department of Lands (IDL) has closed abandoned mine adits (openings) on private property for which permission was granted. There are an unknown number of open mine adits and related safety hazards on other private property within the Gilmore area that the IDL has not accessed [IDL 2020]. Neither EPA nor IDEQ have defined the boundaries of the entire Gilmore Mining Area.

Lemhi County has an average rainfall of 12 inches per year mostly in spring months, and an average snowfall of 40 inches per year that usually occurs mid-November through mid-March. July is the warmest month and January the coldest [USA FACTS 2023]. The Gilmore area elevation is more than 7,000 feet above sea level. Recreation and visitation at the site primarily occur from April through mid-November when snow is not covering the ground. The surrounding hills may have snow and colder days for longer.

Figure 1. General map location of Gilmore area in Eastern Idaho.

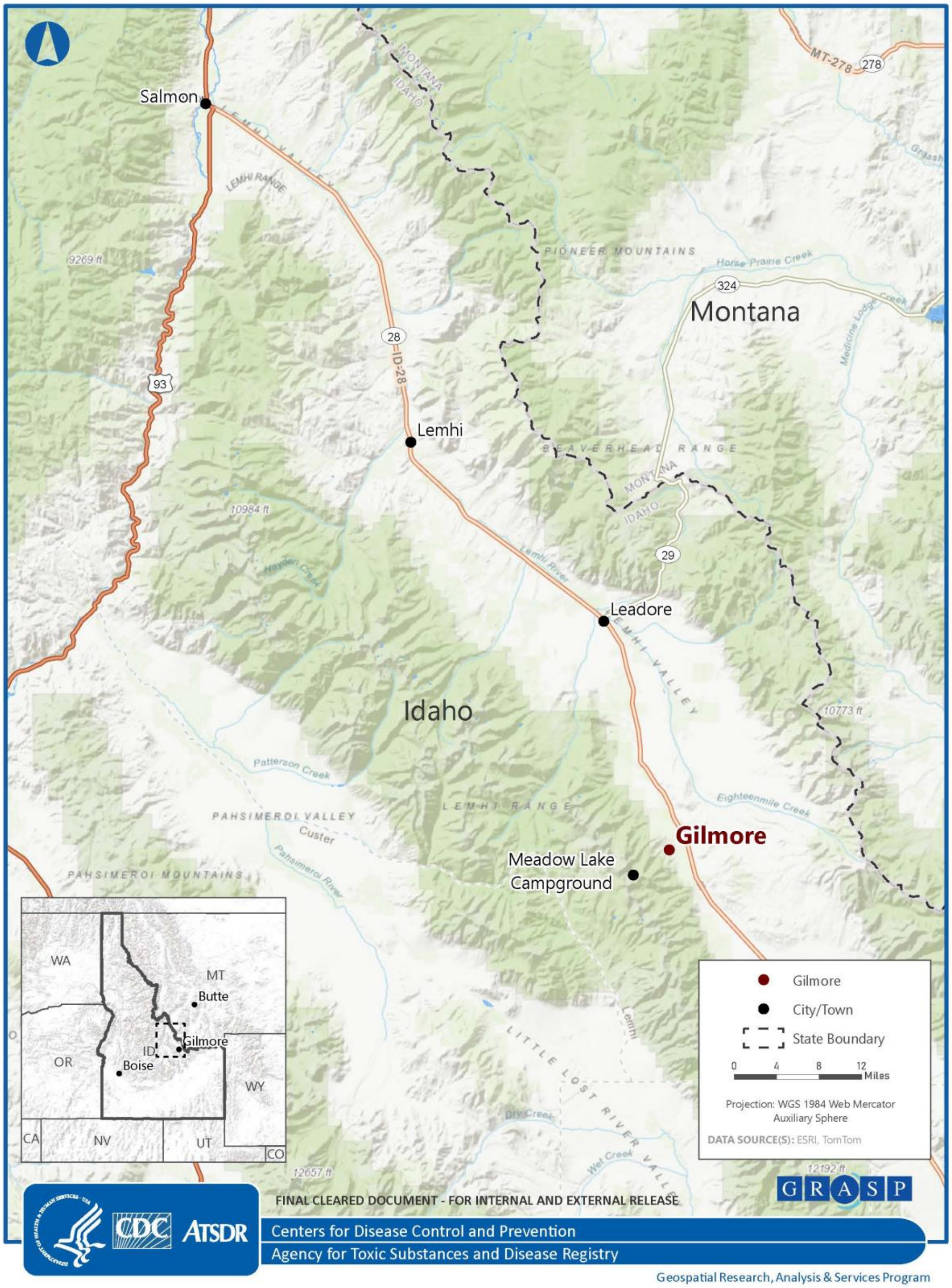
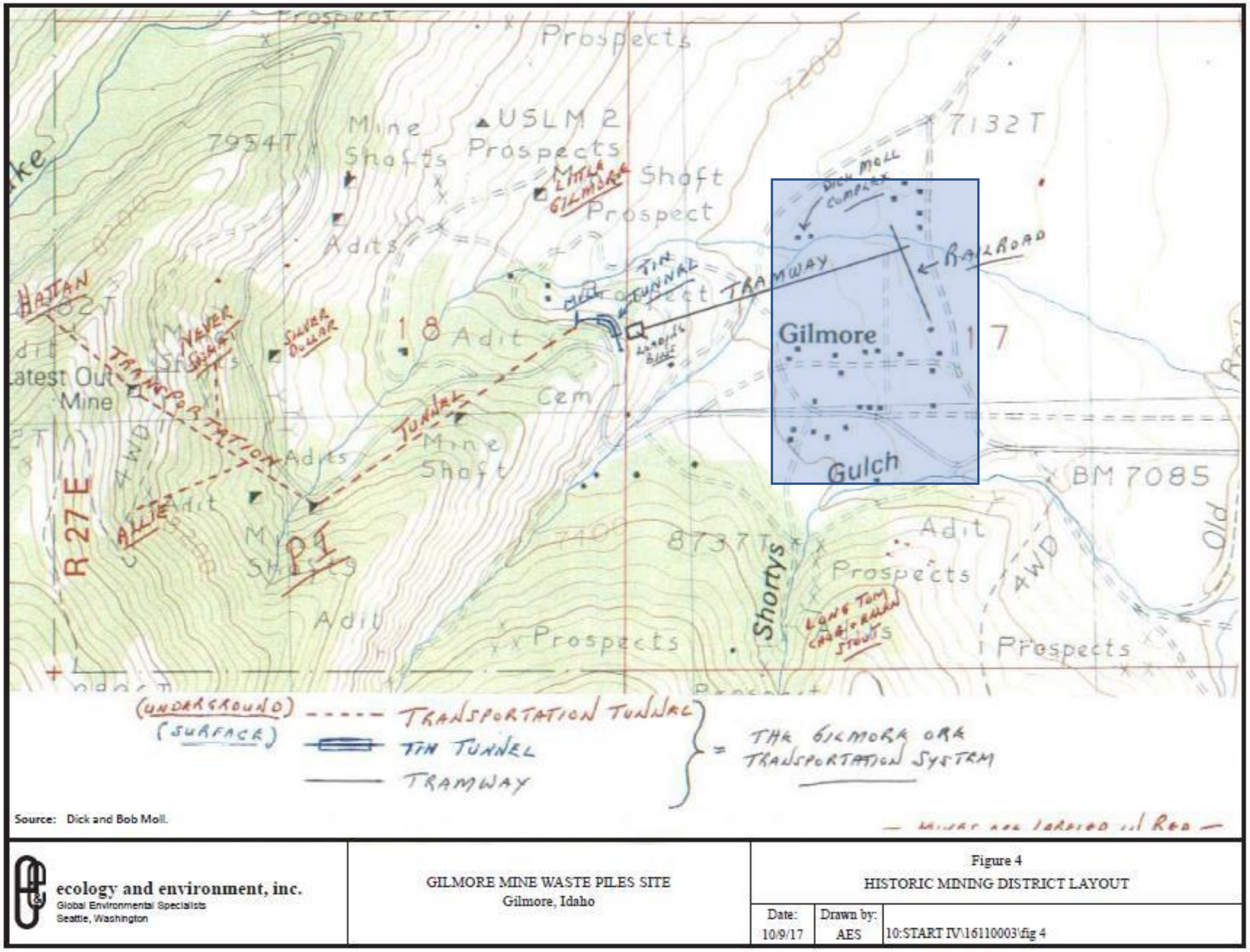


Figure 2. Historic Mining District Layout, Gilmore, Idaho with approximate location of townsite in blue box [E&E 2017; Moll and Moll, No Date].



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Gilmore Townsite. The Gilmore townsite, located east and downgradient of the mining district, was founded to support mining operations within the district; it was abandoned in 1965. The townsite of approximately 90 acres has been described in previous reports [IDEQ 2010; IDEQ 2011, IDEQ/TerraGraphics 2017, E&E 2017, IDEQ/Alta 2022]. About 170 parcels ranging from approximately 0.1 to 1.2 acres are in the townsite [Lemhi County Assessor 2022]. The area has not been recently surveyed. The parcels are privately owned with owners living in Lemhi County and throughout Idaho, Utah, and other states. For the most part, owners do not live onsite but elsewhere. Most owners use recreational vehicles or onsite historical buildings when they visit the site, and they stay for varying amounts of time. There are no public utilities, water systems, or active community buildings such as churches or schools at this undeveloped townsite. Properties at the townsite are occupied annually or seasonally with varying kinds of dwellings including houses, cabins, mobile homes, and recreational vehicles. Use has increased since 2017 [IDEQ/TerraGraphics 2017; Gruenberg and Johnson 2021]. A property company purchased multiple townsite lots and resold them in the last few years, listing them as “sold out” [MLLC 2021]. Ownership of the roads has not been determined (Kostka 2022, personal communication). A USFS dirt road transects the southern portion of the townsite and leads to a heavily used recreational area and the USFS Meadow Lake Campground. The webpage for the campground lists “Gilmore Ghost Town” as a nearby attraction [USFS 2021]. Historically, transport of mine products traversed what are now parcels in the northern part of the townsite. A few parcels have new buildings.

3. Community description and concerns

3.1. Exposed population

The site population is currently mostly transient and varies by season. Many landowners at the site use their properties during summer months as a recreation destination. Limited information exists on the demographics, behaviors, and length of stay of parcel owners, permanent or seasonal residents, and visitors. A community member reported in a recent meeting (March 2023) that approximately six parcels are inhabited in Gilmore year-round. The census tract that encompasses the Gilmore townsite (16059970300) has a 2020 Social Vulnerability Index of 0.6, indicating a medium to high level of vulnerability in comparison to other areas of Idaho [ATSDR 2020a]. During site visits, agency staff observed child play areas, including a swing set.

In 2021, IDHW and EIPH observed both in-state and out-of-state license plates during their visit [Gruenberg and Johnson 2021]. During multiple sampling events, staff observed people coming to the townsite in recreational vehicles for varying lengths of time. People visit the Gilmore sign area or pass through the townsite on their way to the Meadow Lake Campground. People staying in the area engage in activities that create dust such as bicycle riding and use of all-terrain vehicles (ATVs). The area is a popular destination for hiking, fishing, and hunting. During a SoilSHOP[1] event (July 2022), over 40 recreational vehicles were observed.

The Shoshone and Bannocks entered peace treaties with the U.S. in 1863 and 1868 [US & Eastern Shoshone Bannock Tribes 1868]. Shoshone-Bannock tribal members frequent this area on their way to gather, hunt, and fish, as part of their traditional range. They collect medicinal plants during the spring just after snow melt and mix soil collected in the area with water for drinking and as a salve for the skin during traditional practices.

3.2 Outreach with property owners at Gilmore

Multiple activities have worked to inform people of risks at the site.

- IDEQ and IDHW put up signage to warn visitors about physical risks of mine openings and general risks of exposure to lead in soil [IDEQ/TerraGraphics 2017].
- IDEQ mailed sampling results and a fact sheet to property owners describing the physical risks of mine openings and the risks of exposure to lead in soil [IDEQ 2018, IDHW 2018].
- Some landowners have installed barbed wire fencing to restrict access to tailings.
- IDL closed abandoned mine shafts on private property on which permission was granted [IDL 2020].
- IDEQ and IDHW mailed a letter to all landowners in 2022 warning of risks from lead in soil [IDEQ/IDHW 2022].
- IDEQ, IDHW, EPA, and ATSDR conducted a SoilSHOP[1] offering free soil screening and conversations about exposures in July 2022. At this event, there were 50 people staying at Gilmore who the team interacted with. Some were interested to learn about lead in soil on

[1] Soil Screening, Health, Outreach, and Partnership (soilSHOP) events provide community members with free lead screening of soil gathered from their gardens or outdoor play area(s). Although the XRF is a well-accepted and commonly used field instrument for screening soil, limitations exist to this type of screening.

Some limitations include:

*sample preparation and moisture content may affect the precision and accuracy of the result.
*soil samples may not be representative of an entire yard or neighborhood.
*soil screening results will likely vary widely depending on factors such as where the sample was collected in the yard, at what depth it was collected, and what the conditions of the soil were at the time of sampling.

Soil screening results from a soilSHOP event won't tell people what the levels of lead are in untested areas of their yard. Therefore, we give people information about how to get additional soil testing done if they are concerned about lead levels in the rest of their yard.

their property and how to reduce exposures, while others were concerned about agency involvement.

The effectiveness of these measures at Gilmore has not been assessed; however, a recent visit by IDHW observed people exploring an abandoned mine [Gruenberg and Johnson 2021].

4. Environmental sampling

Some environmental sampling of particulates in ambient air, well water, mining waste, roads, townsite soil (including former ore transport areas), creek bed sediment, and surface water has occurred for lead and other heavy metals in the Gilmore area. This report focuses on exposures to lead in soil. Other metals and pathways require further evaluation; however, currently, there are insufficient data to explore other pathways of exposure.

This report evaluates concentrations of lead in surface soil on sampled townsite parcels, and on townsite roads. Soil sampling methods and results for those samples are described in section 5.2 below.

Descriptions of lead sampling data available for mining waste source piles, creek bed sediment, surface water, well water and ambient outdoor air are insufficient to use in this evaluation but are summarized and provided in Appendix A.

5. Scientific evaluations

5.1. Health effects of lead

No safe blood lead level exists; even low levels cause harm. In 2021, CDC updated the blood lead reference value (BLRV) to 3.5 µg/dL [Ruckart et. al 2021]. This value identifies children with blood lead levels that are higher than most children's levels and is based on the 97.5th percentile of the blood lead values among U.S. children ages 1–5 years from 2015–2016 and 2017–2018 National Health and Nutrition Examination Survey (NHANES) cycles. Children with blood lead levels at or above the BLRV represent those at the top 2.5% with the highest blood lead levels in the U.S. [CDC 2021]. The National Institute for Occupational Safety and Health (NIOSH) uses 5 µg/dL as the blood lead reference level for adults [NIOSH 2023].

ATSDR reviewed the health effects of lead exposure in its toxicological profile for lead [ATSDR 2020b] and summarizes them here. The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The nervous system is the organ system most affected by lead exposure in children and adults.

Children are more vulnerable to lead poisoning than adults because their nervous systems are still developing. Children can be exposed to lead in their environment and before birth from lead in their mother's body. At lower levels of exposure, lead can decrease mental development, especially learning, intelligence, and behavior. Physical growth may also be decreased. A child who swallows large amounts of lead may develop anemia (low iron in the blood), severe stomachache, muscle weakness, and brain damage. Exposure to lead during pregnancy can result in premature births. Some effects of lead poisoning in a child may continue into adulthood.

In adults, long-term exposure can result in decreased learning, memory, attention, and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia and damage to the kidneys. It can also increase blood pressure, particularly in middle-aged and older individuals. In pregnant women, exposure to high levels of lead may cause a miscarriage. In men it can cause damage to reproductive organs. EPA has characterized lead as a probable human carcinogen (category B2), based on sufficient evidence of carcinogenicity in animals [EPA 1988].

The associations between lead and health have primarily been derived from chronic exposures; the health effects of acute (short-term) exposure to lead in soil are not as well understood as the health impacts from chronic exposure [EPA 2003a, Stalcup 2016]. However, high acute exposures to lead can result in adverse health effects.

Prevention of Health Effects of Lead. Primary prevention, the removal of lead hazards before a child is exposed, is the most effective way to ensure that children do not experience harmful long-term effects of lead exposure [ACCLPP 2012, CDC 2021]. Soil remediation can be effective at reducing human health risk from lead [Robert Wood Johnson Foundation 2017].

Secondary prevention, which aims to reduce or halt the progression of a medical condition after a lead exposure has occurred, has limitations. A blood test is the best way to determine how much lead a child has been exposed to. For sporadic exposures, children should be tested soon after their last exposure, because the half-life of lead in blood is approximately one month (ATSDR 2020b). Most children with lead in their body have no obvious symptoms. Based on blood test results, health care providers can recommend follow-up actions and care.

5.2. Exposure pathway analysis

ATSDR, IDHW, and other agencies have little understanding about the frequency and duration of people's visits to the Gilmore area. Snow covers the ground from mid-November to mid-March in most years. While many visitors stay in Gilmore, some are just passing through to visit the historical signs/buildings or hike, bike, ATV, camp, harvest, fish, or hunt in nearby hills.

Exposure to lead in soil. Children can be exposed to lead in soil by swallowing or breathing in lead-contaminated soil while playing. Young children tend to put their hands, which may be contaminated with lead dust from soil, into their mouths. Some young children eat soil (this is called pica). Adults may also be exposed by swallowing or breathing in lead contaminated soil or dust while outside or in contaminated indoor environments. Working, digging, or excavating soil increases exposure. Exposure from visiting, trespassing, or playing on mine tailing piles or mine adits may occur, though this is reported to be verbally discouraged by private property owners.

Lead-contaminated soil particles can be brought inside as lead dust on shoes, clothing, or pets. In dusty areas such as Gilmore, fine dust may also enter a dwelling through windows or doors. While a mobile home or recreational vehicle may be temporarily located in Gilmore, exposure to the soil or dust gathered from Gilmore may continue to occur after leaving the Gilmore area.

There are very few wells for access to water, and no other utilities such as power, sewer, septic, etc. in Gilmore. For most visitors, cleaning and washing is limited to the water brought onsite or is done after leaving the area. Decreased washing of hands and housecleaning may result in an increased lead exposure.

Tribal members reportedly use soil from the Gilmore mine areas mixed with water for drinking or as a salve during traditional practices. The specific soil used in these practices will determine the extent of exposure and health effects a person might experience.

Exposure pathways with limited data and understanding. This document focuses on lead exposures through the incidental ingestion of soil. We had insufficient data to focus on other potential exposure pathways to lead. Future evaluations of exposure may be conducted in the future if those data become available. Those additional potential exposure pathways include:

- Outside ambient air. Activities that increase the amount of dust in the air may result in increased exposures from dust inhalation. Vehicles, ATVs, and bikes have been observed to increase dust from roads or pathways, which is a source of lead. Waste piles are not enclosed nor are they covered. Windy conditions may blow fugitive dust from tailing piles into the air as the piles are not covered.

- Surface water or sediment. As water transects the area in the spring after snowmelt, lead from soil or soil itself may be displaced from the source piles, contaminated areas, or roads, and moved onto different properties throughout the site. ATSDR does not know how residents or visitors interact with the sediment in these areas or in areas that transect private parcels.

- Food and medicinal use of plants. Given the lack of water, dry summer conditions, and high elevation, gardening is not expected to occur at the site. Free-range cattle have grazed in the area. A water trough is present on the east border of the townsite [Gruenberg and Johnson 2021]. Cattle on site may be exposed to lead, but the extent of exposure has not been determined. ATSDR does not know where these cattle are marketed. ATSDR could not find information on fish species in, or use of, Texas Creek or other areas potentially impacted by lead in sediment or surface water. The Gilmore area is on the way to areas tribal members visit to harvest medicinal plants (in early spring), fish, and hunt, but there is not enough information to determine how Gilmore might contribute to their overall lead exposures.

5.3. Evaluation of lead in soil

5.3.1. Lead in soil of townsite parcels

Soil lead concentrations from parcels were used to develop the exposure units described below. IDEQ contractors collected surface soil samples during the summers of 2016 and 2017 (Figure 3) [TerraGraphics 2016, IDEQ/TerraGraphics 2017, IDEQ/Alta 2022]. Parcels sampled in the northern section had higher lead levels than those in the central or southern sections. Notably, the soil lead concentration on one parcel's children's play area was 20,500 mg/kg. Parcel soil lead concentrations ranged from 133–32,300 mg/kg (Table 1).

- In 2016, composite samples from parcels consisted of 30 equal volume subsamples taken from 0–2 inches from multiple locations on each parcel and sieved with a 60-mesh screen [TerraGraphics 2016, IDEQ/TerraGraphics 2017, IDEQ/Alta 2022]. Some parcels had composite samples from multiple areas, triplicate samples, soil taken from below the surface, or processed with a 10-mesh sieve.
- In 2017, incremental sampling methodology (ISM) samples were collected and prepared/analyzed by EPA's Manchester Environmental Laboratory for metals [IDEQ/Alta 2022]. These ISM samples consisted of equal volumes of soil from a depth of 0–3 inches from 30 or 100 subsample locations and sieved with an 80-mesh screen for each decision unit.

5.2.2 Lead in soil of dirt roads

Townsite dirt road segments were sampled and are a source of lead among the parcels (Figure 4). Road segments were included in the exposure units described below. Based on the levels of lead on the surface of some of the roads, it is likely that mine tailings have been used to cover the roads or that roads were built through contaminated areas in the townsite. Surface lead concentrations of townsite road segments sampled in 2016 and 2017 ranged from 151 to 26,100 mg/kg (Table 1). The USFS service road that crosses the townsite at the south had the lowest measured lead levels. In 2016, subsurface samples at depths of 2–12 inches and 12–24 inches were also taken from the northern loop road. Lead levels for these were 26,400 mg/kg and 42,900 mg/kg, respectively [Thorhaug 2016, IDEQ/TerraGraphics 2017, Thorhaug 2018, IDEQ/Alta 2022].

Figure 3. Soil sample locations on townsite parcels in A) 2016 and B) 2017 [IDEQ/Alta 2022].

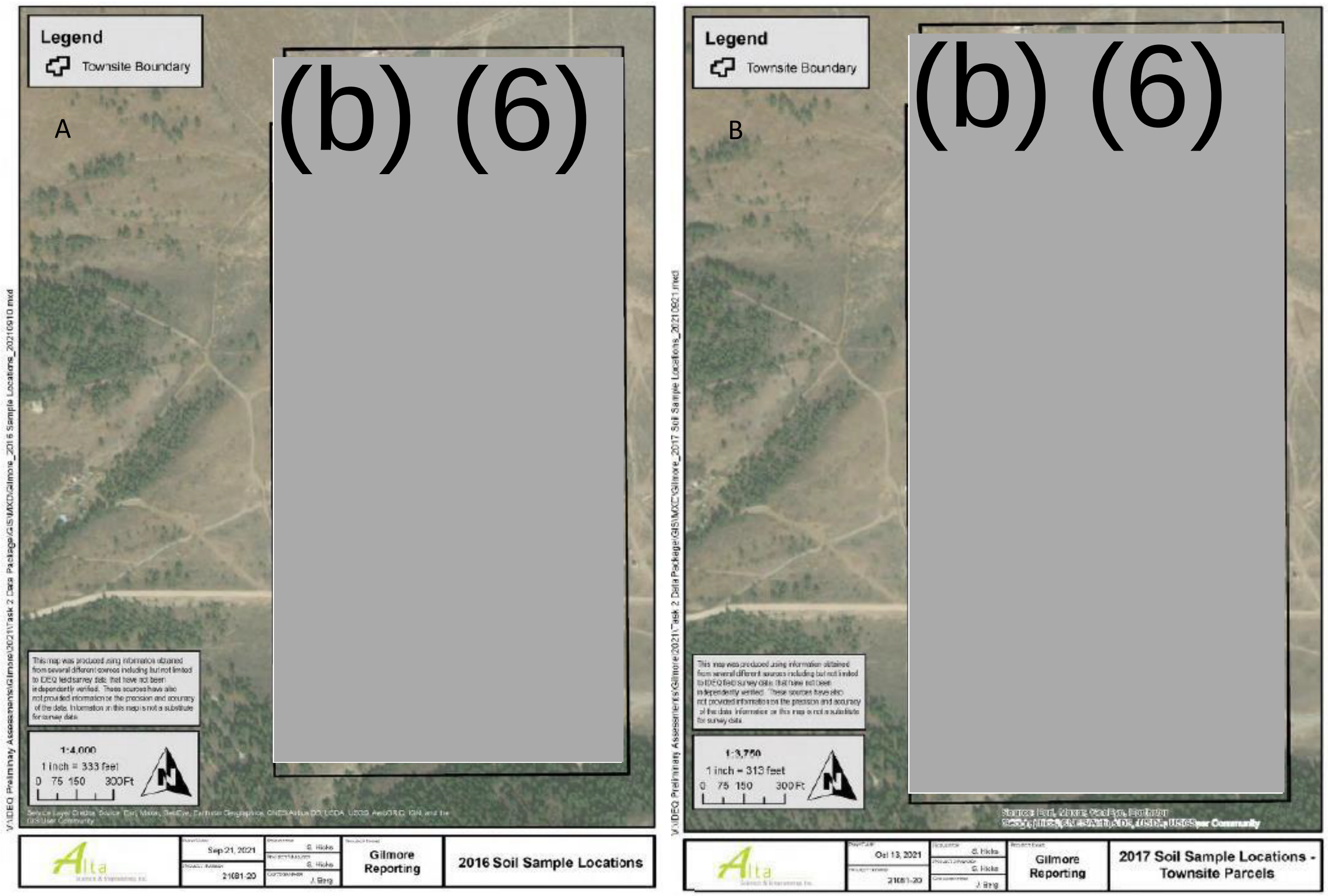


Figure 4. Soil sample locations (decision units) of waste piles, townsite roads, land trust parcel, and BLM parcels in 2017, Gilmore, Idaho [IDEQ/Alta 2022].

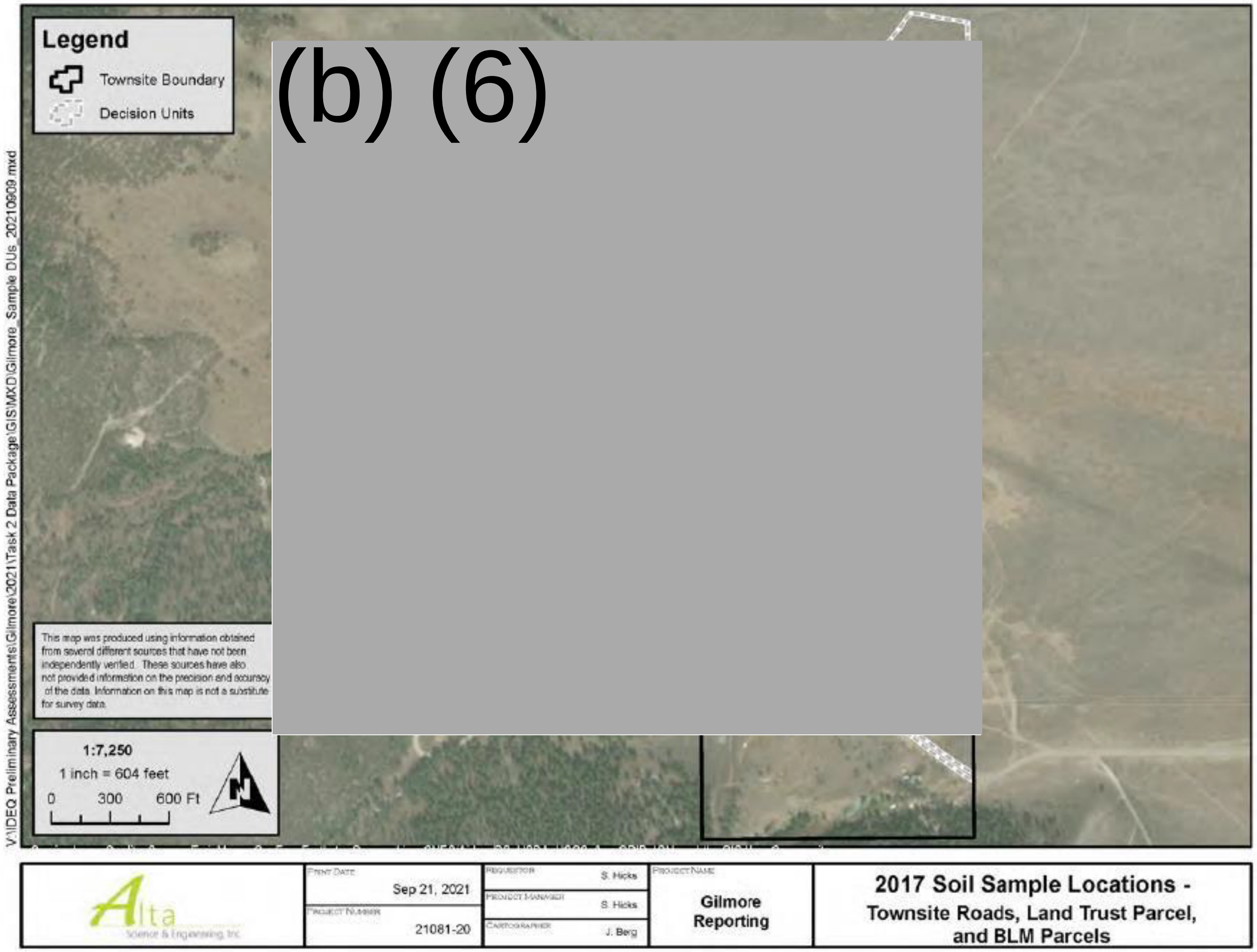


Table 1. Overview of surface soil lead concentrations in the Gilmore mining area and townsite, Lemhi County, ID

Year Sampled	Location Description	Number of Locations	Sample Type	Range of Lead Concentrations in Surface Soil (mg/kg)
2016	Background (BLM)	2	Grab	65.7 – 129
2017	Background (BLM, USFS)	3	ISM 30-point composite (1) and grab samples (2)	120(J) – 163(J)
2016	**Townsite Parcels** †	37*	Composite	113 – 24,033§§
2017	**Townsite Parcels** †	25*	ISM 30-point Composite	151 – 20,500
2016	**Townsite Road Segments**§ †	4	Composite	151 – 26,100
2017	**Townsite Road Segments**†	12	ISM 30-point Composite	278 – 15,700
2017	Waste piles#	6	ISM 30-point Composite	11,700 – 41,200
2016	Area wide (BLM property)	8	Composite (5) or Grab (3)	3,030 – 42,750§§
2017	Area wide (BLM property)	7	ISM 100-point Composite	643 – 29,500
2017	Area wide (Land Trust)	2	ISM 30-point Composite	1,080 – 4,310
2017	Sediment (dry) upstream	6 (1)**	Grab	36.6 – 147
2017	Sediment (dry) at site	14	Grab	486 (J) – 35,700
2017	Sediment (dry) downstream	4 (2)††	Grab	2,890 – 39,900 (J)
2017	Sediment 15 miles downstream	3	Grab	7.1 (J) – 38.7 (J)

Source: [IDEQ/Alta 2022]

Abbreviations: BLM – U.S. Bureau of Land Management; ISM – incremental sampling methodology, *J* – Analytical notation indicating an estimated value; mg/kg – milligrams of lead per kilogram of soil (same as parts per million), USFS – U.S. Forest Service; **bold** – data used in this assessment

Notes:

* Some townsite parcels had multiple decision unit sampling, 4 during 2016 and 2 during 2017 sampling events. Each independent decision unit sample is shown; however, duplicates or triplicates from 2016 were averaged

† Both parcel and roads data in bold were used to develop the exposure units in this report.

§ Road samples 0–2 inches deep, deeper samples increased in concentration in northern loop (not shown here).

Includes data from waste piles and impacted soil near the piles.

**One sediment sample outlier (2,620 mg/kg) was collected near the road and close to where the seasonal stream from the site converges with it. While it is labeled "upstream", it may not be.

†† Two other samples near confluences related to Meadow Lake Creek were 219 – 387 mg/kg.

§§Result at upper end of range is the average of two to three replicate samples.

5.2.3 Bioavailability of lead in soil

In 2017, two soil samples were analyzed for *in vitro* bioaccessibility of lead [IDEQ/Alta 2022]. The source area sample was a composite of all six 2017 ISM samples from source areas and the northern townsite sample was a composite of six northern 2017 ISM samples with the highest XRF readings. The calculated relative bioavailability was 55% for both samples, and the absolute bioavailability was 28% and 27% for the source and townsite composite samples, respectively.

5.3 Exposure Point Concentrations

Appendix B provides a detailed description of how exposure point concentrations of lead were developed. ATSDR developed seven exposure units within the Gilmore townsite (Figure 5). The exposure units represent the range of exposures that may be experienced at the townsite by landowners or visitors.

5.3.1 Area-weighted average surface soil lead concentration

Data from private parcels, common use parcels (with historical buildings), and road segments in the townsite were included in the exposure units. The parcel sample locations were not randomly selected; they were convenience samples from parcels where owners provided consent to sample. Details regarding the specific participants/parcels are not provided, to protect the privacy of personal information about individual properties. Lead concentrations on road surfaces within exposure unit boundaries were included in the exposure unit calculations. For each exposure unit, the area-weighted average surface soil lead concentration only describes the specific areas where soil was sampled (Figure 3, Table 2). This concentration does not represent or describe soil lead concentrations throughout the entire exposure unit. **The area-weighted average soil concentration cannot be statistically extrapolated to unsampled areas within an exposure unit**. To feed into the blood lead prediction tools, these areas were further weighted based on the hypothetical time spent at the townsite site using EPA's method to assess intermittent exposures [EPA 2003a].

Table 2. Summary of area-weighted surface soil concentrations of lead based on areas* sampled for exposure units.

Exposure Unit †	Percent of Total Area Sampled	Range of Surface Soil Concentrations of Lead (mg/kg) §	Area-weighted Average Surface Soil Concentration (mg/kg) of lead †
1-Northwest (1-NW)	20%	2,450 – 24,033	13,385
2-Northeast (2-NE)	15%	816 – 20,500	9,279
3-Central (3-C)	13%	182 – 2,230	1,136
4-Southeast (4-SE)	14%	326 – 4,340	1,643
5-Central (5-C)	24%	278 – 1510	635
6-South (6-S)	35%	113 – 197	161
7-Southwest (7-SW) *	12%	409 – 4,340	2,303

Source: Soil data [IDEQ/Alta 2022].

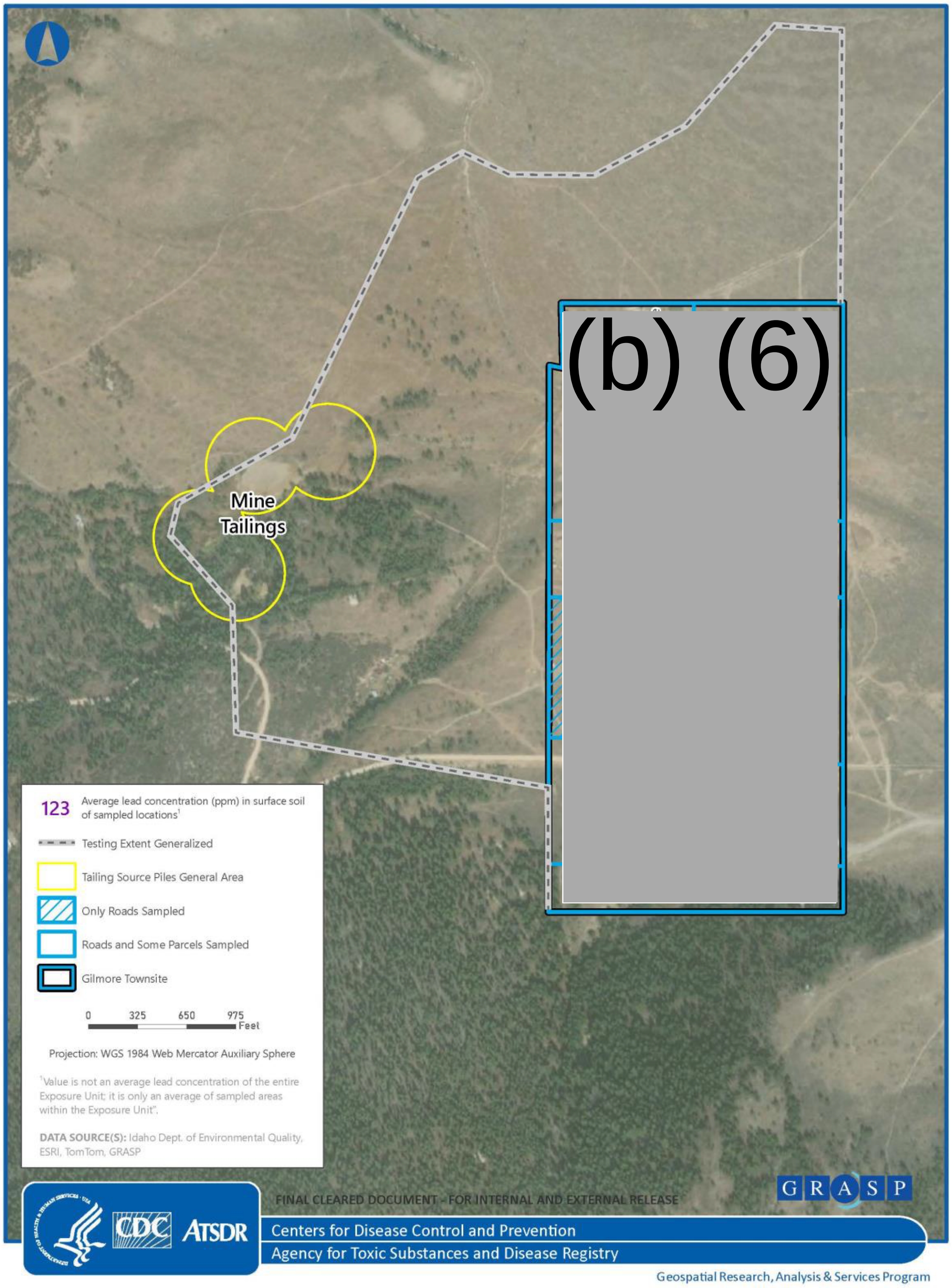
Abbreviations: mg/kg – milligrams lead per kilogram soil

Notes: * Areas sampled included road segments, private parcels, and community use parcels; 7-SW included roads only (no parcels).

† Surface area-weighted average soil lead concentrations only describe the specific areas where soil was sampled. Since not all parcels were sampled and were not randomly selected, they do not represent or describe the average soil lead concentrations throughout each exposure unit.

§ Number of areas sampled in each exposure unit ranged from 4 to 15.

Figure 5. Surface area-weighted soil lead concentrations for areas sampled in each ATSDR exposure unit, Gilmore Townsite, ID.



5.3.2 Time-weighted average surface soil lead concentrations

ATSDR developed three exposure scenarios to come up with exposure point concentrations to use in the blood lead modeling tools. Activities for adults and children vary and may include walking, playing, riding bikes or ATVs outside through the townsite impacting the actual level of exposure. Likewise, adults or children may ride through the mining area on the way to go hiking, exploring, hunting, or fishing in the surrounding hills. A detailed description of the method calculations is included in Appendix B. ATSDR assumed a

- **part-time visitor** stays the night in the mine area on average at least once per week (1/7 days) for 90 days (~13 days).
- **frequent visitor** stays in the townsite (or nearby parcel) on average at least twice per week (2/7 days) for 90 days (~26 days).
- **seasonal resident** or future resident stays or lives in the townsite for at least 90 days or more.
- **full-time resident** lives at the townsite and may be exposed to soil for at least six months when there is no snow cover and temperatures begin to increase (adult model for fetus of pregnant woman only).

> Steady state is achieved when the rate of lead intake is equal to the rate of lead elimination. It takes 90 days to achieve a **quasi (almost) steady state blood lead level**. Several factors influence intake and elimination, including retention in bone.

An **area visitor** may briefly stop in the townsite as they drive by on the highway or on their way to the surrounding hills beyond the Gilmore mining area such as the Meadow Lake Campground. ATSDR cannot estimate the impact of the site for this exposure duration because the exposure does not achieve a quasi-steady state blood lead level.

5.4 Predicting blood lead levels in the Gilmore area

5.4.1 Children's blood lead

ATSDR used EPA's integrated exposure uptake biokinetic (IEUBK) model to estimate blood lead levels in children under six years old who are exposed to lead-contaminated soil [SRC 2021]. The methodology and detailed analysis can be found in Appendix B. IEUBK estimates a plausible distribution of blood lead concentrations centered on a geometric

> **CDC recommends blood lead testing for children enrolled in Medicaid or if exposed to a known source of lead.**
>
> If a patient's venous blood lead level is ≥ 3.5 µg/dL, CDC recommends the health care provider complete an exposure history, review diet and nutrition with focus on calcium and iron intake and ensure the child does not have iron deficiency, check the child's development milestones, refer caregivers to supportive services, as needed, and complete follow up venous blood lead testing within 1 3 months. An environmental investigation of the potential sources and a lead hazard reduction program is warranted.
>
> If confirmed with a venous sample at 20 µg/dL, blood lead levels should be re checked within two weeks to one month and more investigations and diagnostics may occur to find source.
>
> See Recommended Actions Based on Blood Lead Levels | Lead | CDC

blood lead concentration for a hypothetical child or population of similarly exposed children. IEUBK estimates around the CDC BLRV (3.5 µg/dL) are uncertain as the model is only validated down to 5 µg/dL. IEUBK requires a minimum exposure of one day per week for 90 days to reach a steady state concentration in the blood. ATSDR did not predict blood lead levels to children visiting Gilmore for less than 13 days over a 90-day period.

ATSDR found that the probability of a child's (12–72 months) blood lead being above 5 µg/dL occurs under many scenarios and increases with the amount of time spent at the site (Table 3). Children visiting the most southern area (6-S) at the site have less than a 5% probability of having a site-related increase in blood lead greater than 5 µg/dL. Likewise, a child visiting exposure units 3-C and 5-C once a week for 90 days is not predicted to have an increase in blood lead greater than 5 µg/dL. As shown in Figure 6, lead soil concentrations of sampled properties in the 1-NW exposure unit resulted in a 90% chance of a child having a blood lead level greater than 20 µg/dL for the 90-day resident exposure group. In areas 1-NW and 2-NE, the predicted average blood lead of children less than 24 months is greater than 10 µg/dL for all three exposure groups (data not shown).

Table 3. Probability of a Child (12–72 months) with Blood Lead Level Exceeding a Target Level of Concern* (5 µg/dL) on Sampled Properties, Gilmore Townsite, ID

Exposure Unit †	**Resident (90d or more):** Probability of a Child Blood Lead's ≥ 5 µg/dL* (Percent)	**Frequent Visitor (2d/wk 90d):** Probability of a Child Blood Lead ≥ 5 µg/dL* (Percent)	**Part-time Visitor (1d/wk 90d):** Probability of a Child Blood Lead ≥ 5 µg/dL* (Percent)
1-Northwest	**100 % ****	**100 % ****	**95 % ****
2-Northeast	**100 % ****	**98 % ****	**86 % ****
3-Central	**78 % ****	**17 % ****	4.4 %
4-Southeast	**91 % ****	**31 % ****	**9.1 % ****
5-Central	**45 % ****	**5.2 % ****	1.5 %
6-South	3.1 %	0.55 %	0.34 %
7-Southwest †	**97 % ****	**50 % ****	**17 % ****

Abbreviations: d – day; wk – week; µg/dL – micrograms lead per deciliter of blood,

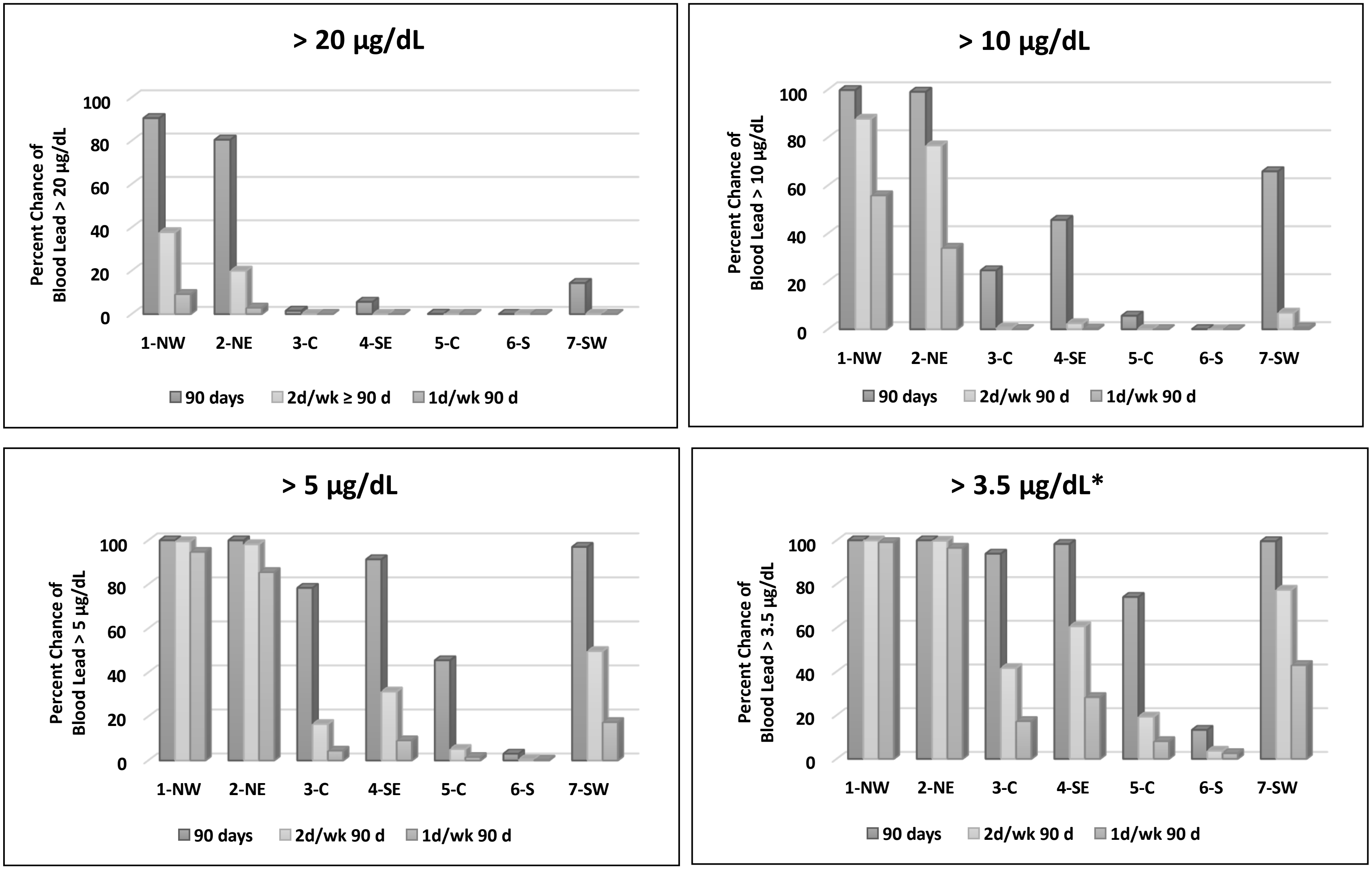
Notes

* Most children in the US (97.5%) have blood lead levels below the CDC BLRV (3.5 µg/dL); however, IEUBK is not validated for use in estimating blood lead levels lower than 5 µg/dL or over 30 µg/dL and may not accurately reflect estimates above 30 µg/dL.

** More than 5% chance of exceeding 5 µg/dL, values **bolded** for effect.

† Each exposure unit describes exposure only to specific areas where soil was sampled (roads and/or parcels). The 7-SW exposure unit consisted of only road samples.

Figure 6. Percent chance a child's (12–72 months) blood lead exceeds an average (geometric mean) blood level[*] of 20, 10, 5 or 3.5 µg/dL when staying at the Gilmore townsite for three summer months or more, two days per week for 90 days, or one day per week for 90 days.



*Values at 3.5 µg/dL uncertain; IEUBK not validated for blood lead levels lower than 5 µg/dL.

5.4.2 Adult and fetal blood lead

ATSDR used EPA's adult lead methodology (ALM) to estimate blood lead for non-residential exposures from one day per week for 90 days up to 180 days [EPA 2003b]. The methodology and detailed analysis can be found in Appendix B. The model was developed to protect the fetus of a woman of child-bearing age who has been exposed to lead. The model output is the average (geometric mean) adult blood lead and the probability of fetal blood lead ≥ 5 µg/dL. As with the IEUBK, the ALM estimates around the CDC BLRV (3.5 µg/dL) are uncertain as the model is only validated down to 5 µg/dL. ALM also requires a minimum exposure of one day per week for 90 days to reach a steady state concentration in the blood. However, the model easily incorporates number of days per year, so exposures to a full-time resident staying at the site for six months with no snow were estimated. ATSDR also increased the soil ingestion rate from 50 mg/day to 200 mg/day [EPA 2022b] to estimate a digging or excavating model in the northern part of the site (the only area we have lead data for soil at depth) for seasonal resident or full-time resident without snow cover.

Tables 4 and 10 show the output of the ALM for exposures at the Gilmore townsite. Pregnant women staying in the northern part of the townsite, from 180 days (no snow cover) to 2 days per week for 90 days, have an estimated blood lead level that would transfer to the fetus's blood at a potentially harmful amount over 5 µg/dL.

The probability of a pregnant woman having an estimated fetal blood lead over 20 µg/dL in the northwest (1-NW) exposure unit is 5.1% for 90-day and 30.4 % for 180-day exposures. The average (geometric mean) adult blood lead in the highest area (1-NW) is predicted to be 8.5 or 16.4 µg/dL, for a 90-day or 180-day exposures, respectively (Table 10, Appendix B).

Table 4. Adult Lead Model Output: Probability of a pregnant woman's fetus having a blood lead greater than or equal to 5 µg/dL on Sampled Properties under four different exposure scenarios, Gilmore Townsite, ID

Exposure Unit *	**Resident Without Snow Cover (180d):** Probability of fetal blood lead ≥ 5 µg/dL† (Percent)	**Seasonal Resident (90d):** Probability of fetal blood lead ≥ 5 µg/dL† (Percent)	**Frequent Visitor (2d/wk 90d):** Probability of fetal blood lead ≥ 5 µg/dL† (Percent)	**Part-time Visitor (1d/wk 90d):** Probability of fetal blood lead ≥ 5 µg/dL† (Percent)
1-Northwest (1-NW)	**96.8 % ****	**76.7 % ****	**13.1 % ****	2.5 %
2-Northeast (2-NE)	**89.4 % ****	**56.2 % ****	**5.6 % ****	1.0 %
3-Central (3-C)	3.7 %	0.6 %	0.1 %	< 0.1 %
4-Southeast (4-SE)	**9.2 % ****	1.6 %	0.1 %	< 0.1 %
5-Central (5-C)	0.8 %	0.2 %	< 0.1 %	< 0.1 %
6-South (6-S)	< 0.1 %	< 0.1 %	< 0.1 %	< 0.1 %
7-Southwest (7-SW) †	**19.1 % ****	3.8 %	0.2 %	0.1 %

Abbreviations: d – day; wk – week; µg/dL – micrograms lead per deciliter of blood

* Each exposure unit describes exposure only to specific areas where soil was sampled (roads or parcels). The 7-SW exposure unit consisted of only road samples.

† Most children (97.5%) in the U.S. have blood lead levels below the CDC BLRV (3.5 µg/dL); however, ALM is not validated for use in estimating blood lead levels lower than 5 µg/dL.

** More than 5% chance of exceeding 5 µg/dL, values **bolded** for effect.

Use of an increased soil ingestion rate for a constructor moving soil at a property in the northwest exposure unit results in geometric average blood lead levels of 64, 32 and 9.6 µg/dL for these activities over 180 days, 90 days, or 2 days/week for 90 days. The percent chance of an adult moving soil having an estimated fetal blood lead over 20 µg/dL for exposures lasting 180 days, 90 days, or 2 days/week for 90 days in 1-NW exposure unit is predicted to be 96.4%, 73.7% or 5.1%.

5.4. Limitations and Uncertainties

Although specific blood lead estimates for a variety of scenarios are shown in the IEUBK outputs (Tables 3, 4, 8, 9, and 10, Appendix B), there is uncertainty in these values.

- **Frequency and duration of visitors**. Little to no information is known about the actual frequency of people coming to the site as residents, frequent visitors (2 days/week for 90 days), or part time visitors (1 day/week for 90 days). Limited information is available about where people spend time and how long they spend time in different locations.

- **Additional site-specific lead exposure pathways not included in model**. Several exposure pathways to lead were not included in the model due to insufficient data. Most importantly, inhalation exposure to lead on dust particles was not included in the model. The drinking water pathway was also not included.
- **Lead exposure at other locations**. There is a lack of knowledge of lead concentration in soil where people spend the rest of their time when not at the site. In our models, we assumed that the lead concentrations in off-site soil was 32.3 mg/kg, which is the average (95UCL) of lead concentrations found across Idaho [Smith et al. 2013]. This value is lower than the urban default value in IEUBK (200 mg/kg). ATSDR's modeled blood lead levels for site users may be over- or under-estimated, depending on whether site visitors spend their off-site time amidst soil with a lead value lower or higher than 32.3 mg/kg, respectively. Gilmore parcel owners come from all over Idaho (mostly), Utah, and other states.
- **Sampling used 60- or 80-mesh screens**. EPA recommends 100-mesh screen (finer than 60- or 80-mesh) to analyze finer particles that would stick to hands that could be accidentally ingested [EPA 2016b]. If smaller particles are enriched with lead compared to larger particles, blood lead estimates may be underestimated. Larger particles are less likely to stick to hands and be ingested.
- **Soil ingestion rates**. As a component of the IEUBK model, lead uptake rates are uncertain in recreational areas where activities might markedly increase soil ingestion [EPA 2003a]. Activities that could increase soil ingestion might include eating outdoors, camping, bike riding, ATV riding, or reduced hand washing because of limited water availability. If actual soil ingestion is greater than the model's default values, the IEUBK model may underestimate blood lead levels.
- **Time-weighting exposures**. The IEUBK model and the ALM model were designed for daily exposures. Blood lead estimation tools available at this time are not validated for exposures less than 90 days. EPA guidance evaluating seasonal exposures [EPA 2003a] suggests time weighting to adjust intermittent exposure over time. Errors in model assumptions may either over- or underestimate blood lead levels.

Adults or children visiting the Gilmore Mine area once for a few days or less can be exposed to lead in the area, but ATSDR cannot determine if or how much harm is expected from that short exposure. A person may be exposed to lead for a short time and have an increased blood lead level, but without continuing exposure, the body will eliminate the lead or store it in bone, and blood lead will return to a pre-exposure level over the next few months. However, repeated exposures may overwhelm the body's ability to eliminate lead. Additionally, harm can occur from exposures to very high levels of lead in a short amount of time, but predicting harm depends on many factors.

- **Model validation (below 5 µg/dL or above 30 µg/dL)**. The IEUBK model is validated between the target value of 5 µg/dL of lead in blood and an upper blood lead limit of 30 µg/dL [Zaragoza and Hogan 1998]. The IEUBK may not accurately reflect blood lead estimates above or below that range.

- **Model validation (soil lead levels above 5000 mg/kg)**. Soil lead concentrations were measured at levels above what the model was validated to manage (up to 5000 mg/kg) [Zaragoza and Hogan 1998]. The percentage of lead absorbed decreases as the quantity ingested increases [EPA 2003b] resulting in overestimated blood lead levels at very high soil lead levels.
- **Convenience soil sampling**. Soil sampling locations were not randomly distributed throughout the areas where children might spend time. Sampling had characteristics of a convenience sample. The IEUBK model relies on the arithmetic mean of the soil lead concentration to which children are exposed. The arithmetic mean value of lead in soil from a convenience sample may not be representative of a typical child's soil exposure at the Gilmore site.
- **Exposure to other metals**. Interactions between lead and other metals may occur resulting in an increase in the overall toxicity [ATSDR 2004]; the predicted blood lead level may underestimate overall toxicity [ATSDR 2004].

6. Conclusions

ATSDR came to four conclusions about the Gilmore mine area and townsite.

1. **Children and adults residing or visiting the townsite multiple times may accidentally ingest lead-contaminated soil at levels that could harm their health. Pregnant women who visit the site multiple times may ingest lead-contaminated soil at levels that could harm their fetus**. ATSDR considers this situation a past and present public health hazard. ATSDR is not aware of any current or planned primary intervention to reduce lead exposure at the site. Until lead exposures are mitigated, the site will continue to pose a public health hazard into the future.

Basis for conclusion: Children may be repeatedly exposed to levels of surface soil lead in most of the townsite that can harm health. There is no safe level of blood lead. Estimated blood lead levels from staying at the townsite just once a week during the summer months (~13 days) in many areas of the townsite may lead to an exposure that may harm health.

Although most children have no obvious immediate symptoms of lead poisoning, lead can affect almost every organ and system in the body. The nervous system is the main target for lead exposure. At lower levels of exposure, lead can decrease mental development, especially learning, intelligence, and behavior. Physical growth may also be decreased. Most children have no obvious immediate symptoms. Children are more vulnerable to lead poisoning than adults because their nervous system is still developing. Some effects that occur in a child may continue into adulthood. Other effects can occur at higher blood lead levels. Blood lead levels in some children exposed to higher soil lead levels at the townsite should be monitored by a physician.

At most areas of the townsite, adults may be repeatedly exposed to levels of surface soil lead that can harm health. Estimated blood lead levels from staying at the northern portion of the townsite (north of Zinc Street) twice a week during the summer months (~26 days) may lead to an exposure that can harm health. Longer exposure durations may be of concern in other parts of town (between Gold and Lead Street). Drinking water with soil in it during traditional practices may result in higher exposures to tribal members than described through incidental ingestion.

Like in children, the nervous system is the main target for lead poisoning in adults. In adults, long-term exposure can result in decreased learning, memory, attention, and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia and damage to the kidneys. It can also increase blood pressure, particularly in middle-aged and older individuals. In pregnant women, exposure to high levels of lead may cause a miscarriage. The lead body burden of the mother may be transferred to a fetus in the womb, resulting in health effects to the fetus (see above).

2. **People who work, dig, or excavate soil in the mining area or townsite on a regular basis may accidentally swallow more soil and dust than other people. This may lead to blood lead levels of great concern**, especially in the mining areas or in the townsite north of Zinc Street.

Basis for conclusion: The levels of lead on waste piles at Gilmore are very high; some areas have over 40,000 mg/kg (also referred to as parts per million). Actively moving or digging in the piles may result in a one-time high exposure that may result in acute effects and add to the overall body burden. In pregnant workers, exposure to high levels of lead may cause a miscarriage. In men it can cause damage to reproductive organs.

3. **ATSDR does not have enough information to determine how much lead-contaminated dust particles in ambient air contribute to lead exposure over time**. We do not know how much lead is in dust that people breathe when participating in recreational activities, such as riding all-terrain vehicles (ATVs) in contaminated areas. More information is needed about the frequency and duration of lead levels in the air over time.

Basis for conclusion. EPA collected air samples that had lead-contaminated particles at levels of health concern, but we don’t know how lead concentrations in ambient air dust vary during the year. Given the windy nature of the area and the fine dust found on the roads and hillside, it may be possible that dust is being resuspended. Inhaled lead-contaminated dust particles can be accidentally swallowed or absorbed into the bloodstream from the lungs. More sampling over time would allow us to better understand the health risk from lead on dust in the air.

Exposure during recreational or construction activities that create dust in the air such as hiking, bike riding, riding ATVs, riding horses, or excavating/digging soil may increase swallowing or breathing lead-contaminated soil or dust, thus increasing harm to health. We do not have any information about the levels of lead in the dust that is created from these dust-generating activities on the roads or the lands surrounding the townsite. Activity-based sampling is one way we can start to understand the contribution these activities may have on exposure. Activity-based sampling has shown that activities such as ATV riding may result in exposures of health concern from dust or associated contaminants [Newfields 2003; ATSDR 2007].

4. **Adults or children visiting or playing around abandoned mine shafts are at risk for physical harm and may be exposed to harmful contaminants**.

Basis for conclusion: The Idaho Department of Lands (IDL) has closed mine adits in the mining district on private property where owners have granted access [IDL 2020]. However, an unknown number of mine adits remain open, particularly on private property. These may be unstable and collapse. The BLM reports that the leading cause of death at abandoned mines is drowning in water-filled pits and quarries, while the second most common cause of death and injury is falling into vertical underground mine openings. Lethal gases (methane, carbon monoxide, hydrogen sulfide, and toxic levels of carbon dioxide) can accumulate in underground passages—even close to entrances. People can also be exposed to radioactive gases and low-oxygen environments at abandoned mines [BLM 2023].

7. Recommendations

ATSDR has the following recommendations.

For environmental agencies:

1. ATSDR recommends that EPA and IDEQ rapidly assess the area to determine where people (especially children or pregnant women) may contact soil and take actions to reduce exposures to high levels of lead in soil (primary intervention). EPA and IDEQ should also consider options to reduce exposures to fugitive dust from lead-contaminated roads and source pile areas.

2. ATSDR recommends that IDEQ and EPA, in collaboration with IDHW, assess the frequency and duration of people staying in the Gilmore area, as well as their site use activities. This will enhance the ability of health agencies to quantify health risks more accurately and help environmental agencies identify the most effective mitigation strategies to reduce harmful exposures.

3. ATSDR recommends that IDEQ and/or EPA conduct additional assessments to characterize the extent of contamination in and around the Gilmore townsite, including exposure that occurs during recreational activities.

4. ATSDR recommends that IDL and BLM continue to mitigate physical hazards around mine openings in cooperation with private landowners.

For people residing at or visiting the site:

1. ATSDR recommends that pregnant women and parents/guardians of young children who regularly visit the site talk with a physician about this exposure and consider blood lead screening.

2. ATSDR recommends that adults actively working, excavating, digging in soil, or staying at the site on average 2 days per week or more north of Zinc Street should talk with a physician about this exposure and consider blood lead screening.

3. ATSDR recommends behaviors that can reduce exposure (see State of Idaho fact sheet, Appendix C). Avoid breathing in dust when riding ATVs, bike riding, or driving with the windows down. Options to decrease the inhalation of dust include driving more slowly, wearing a mask, and increasing your distance from other vehicles you are following.

4. ATSDR recommends that the Shoshone-Bannock Tribes advise members not to mix soil from the Gilmore mine areas or townsite with water for drinking during traditional practices.

For health agencies:

1. ATSDR recommends that IDHW develop and implement a communication and outreach plan in collaboration with IDEQ, USFS, BLM, EPA, and Eastern Idaho Public Health (EIPH) to expand on outreach activities to date. The plan should identify and implement long-term, evidence-based strategies to reduce exposure to lead and a process to evaluate the effectiveness of interventions.

2. ATSDR recommends that IDHW complete a comprehensive public health assessment evaluating the intermediate and long-term exposures and pathways of contaminants measured in the mine area and townsite when additional data are available.

7.1. Public Health Action Plan

ATSDR will disseminate and discuss findings of this health consultation with townsite property owners, with local, state, and federal health and environmental officials, and with other interested stakeholders.

ATSDR will continue to provide public health-related technical assistance to IDEQ and EPA as they further investigate the site and develop site removal, remedial, or risk mitigation strategies.

ATSDR and IDHW will work with state health and EIPH to educate health care providers and parents, and they will encourage blood lead testing of children who visit the site.

IDEQ will coordinate activities with IDHW, ATSDR, and EPA to better understand the community living and visiting the Gilmore area, the frequency of their stays, and activities that may result in lead exposures.

IDHW will develop and implement a site-specific communication and outreach plan.

IDHW will evaluate remaining site-related contaminants and exposure pathways as data become available, and share findings in published reports.

8. Who prepared the document

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Agency for Toxic Substances and Disease Registry

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Appendices

Appendix A - Environmental samples of lead not evaluated in this report

While not used in the exposure assessment, the following descriptions of source piles and sediment provide context of lead concentrations in the area around the townsite. The areas surrounding the townsite are a recreational draw to visitors and townsite landowners.

Limited information about lead concentrations in well water and ambient outdoor air were also collected. Levels of lead in outdoor dust may be of health concern; additional sampling is needed to comprehensively evaluate the soil inhalation pathway.

Figure 7 shows the sampling locations for outdoor air, waste piles, and streams in the context of townsite locations.

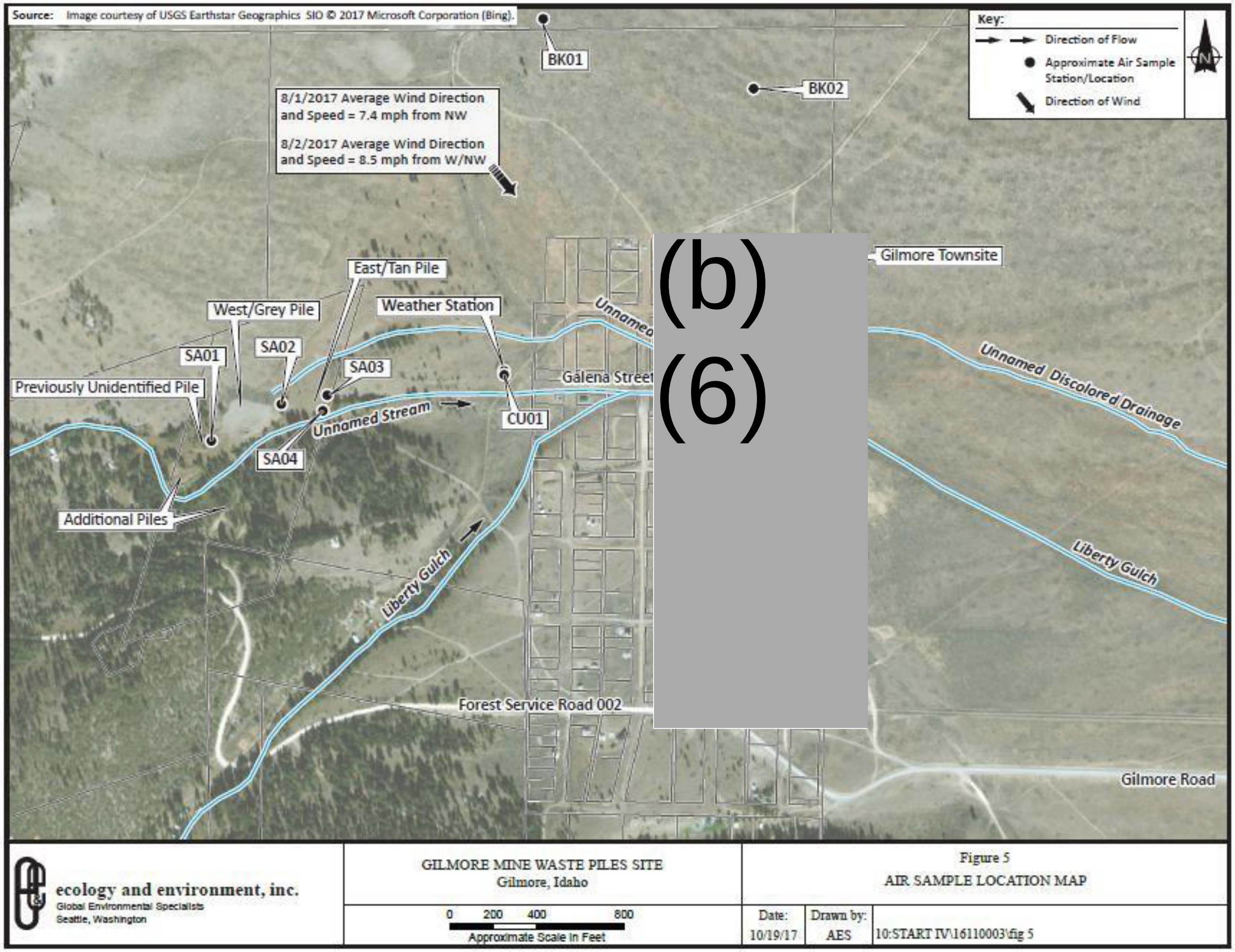
A.1 Lead in mine tailings (source piles) and surrounding areas

Source piles and mine openings are on private properties uphill from the townsite. The area to the north of the mine areas and townsite is owned by BLM; to the east is USFS land. Levels of lead in mining tailing and waste piles sampled in 2017 ranged from 11,700–41,200 mg/kg (summarized in Table 1) [Thorhaug 2016, IDEQ/TerraGraphics 2017, Thorhaug 2018, IDEQ/Alta 2022]. Tailing piles are on private property and should not be accessed by the public; some piles have barbed wire fences to deter visitors. Wind or snow/rain erosion of piles is occurring, releasing contamination from the properties, as is evidenced by concentrations of lead downhill from the piles. Soil lead levels from areas around the townsite owned by BLM ranged between 643–42,750 mg/kg (Table 1). In background areas upgradient of the source piles and the townsite, soil lead levels ranged from 65.7 to ~163 mg/kg for lead. In 2017, IDEQ's contractor used ISM to sample source areas, surrounding areas, roads, and one background sample (Figure 4, Appendix B). Two grab samples of background areas were also taken in 2017.

A.2 Lead in streams and sediment

Lead was not detected (detection limit 0.01 mg/L) in three surface water samples collected 15 miles downstream of the site [IDEQ/Alta 2022]. Three collocated sediment samples ranged from 7.1–38.7 mg/kg lead (all J-flagged). Most of the streams on the hillside above, at, and just downstream of the site are seasonal, and sediment was dry when sampled in 2017. Table 1 summarizes the range of sediment lead levels upstream from the site, at the site, and just downstream of the site. Dry sediment sampled from streams, conveyance ditches and other overland flow paths that cross or originate within the townsite or are just downstream from the site ranged from 486–19,900 mg/kg. Sediment concentrations of lead were not used in this assessment but are shown to indicate movement of lead and contamination via stream beds in the townsite.

Figure 7. Map of air sampling, waste piles, streams, and townsite locations, Gilmore, Idaho [E&E 2017].



A.3 Lead in Drinking Water

Most parcel owners and visitors bring in potable water for use on-site. IDHW identified five private wells in the area [Gruenberg and Johnson 2021]. IDEQ identified eight wells within 4 miles of the site (four within a half mile of the townsite) [IDEQ/Alta 2022]. IDEQ's contractor collected samples from domestic wells on two private properties upgradient from contaminated areas. Lead was not detected above the reporting limit (10 µg/L), which is below the EPA maximum contaminant level (MCL) (15 µg/L). Due to the reporting limit, ATSDR is not able to estimate any additional health risks from lead exposure from drinking water from wells.

A.4 Lead in Air

EPA's contractor collected particulate air samples for about 8–9 hours with one exception (6 hours) [E&E 2017] for two days in August of 2017 at background locations (n=2), source areas (n=4) and the townsite (n=4) (Figure 7, Appendix A). Detection limits varied among samples due to flow rate and collection time differences, which influenced the total volume sampled. Average onsite winds during sampling were mostly from the northwest at an average speed of 7.4 or 8.5 mph on August 1 and 2, respectively. Table 5 summarizes the results of air testing in the Gilmore area. Results were compared to the EPA regional screening level (RSL) (0.15 µg/m^3). Not enough sampling occurred to be compared to the National Ambient Air Quality Standard (NAAQS) (0.15 µg/m^3) as a rolling three-month average [EPA 2008, 2016a, 2022]. On 8/1/2017, lead in air was detected at six sites; four sites were over the RSL, ranging from 0.176 to 0.435 µg/m^3 (source areas and townsite). On 8/2/2017, lead was detected at five sites; one site had lead over the RSL at 0.383 µg/m^3 in the townsite. Given the limited sampling duration, the frequency and extent of this exposure are unknown. Because of the outdoor nature of temporary living structures, common outdoor activities, contamination on dirt roads, fine nature of the dirt, lack of potable water for washing or cleaning dust, and windy nature of the site, there is potential for ongoing inhalation lead exposures.

Table 5. Overview of lead particulates in the air during two-day sampling event, Gilmore, ID (2017)

Area	Station Location	Day 1 (8/1/2017) Lead Concentration in Air (µg/m^3)	Day 2 (8/2/2017) Lead Concentration in Air (µg/m^3)
Background	BK01	<0.0128 U	<0.0181 U
	BK02	<0.0168 U	<0.0247 U
Source Areas	SA01	0.100	<0.0299 U
	SA02	<0.0565 U	<0.0494 U
	SA03	**0.176***	0.0886
	SA04	**0.238***	0.106
Common Use Areas (townsite)	CU01	0.0889	<0.0267 U
	CU02	<0.0626 U	<0.0783 U
	CU03	**0.241***	**0.383***
	CU04	**0.435***	0.107

Source: [E&E 2017].
Abbreviations: µg/m^3 – microgram per cubic meter; U – Analyzed but undetected at indicated detection limit;
Notes: Samples analyzed by NIOSH Method 7300 (ICPMS)
* Above the EPA regional screening level of 0.15 µg/m^3 for residential outdoor air [EPA 2022a], values **bolded** for effect

Appendix B - Soil lead data analysis and predicting blood lead levels

ATSDR developed seven exposure units within the Gilmore townsite. These seven areas represent the range of exposures to lead that may be experienced at the townsite by landowners and visitors during the summer season at least once a week (~13 days), twice a week (~26 days), or for the summer (90 days or more).

B.1 Soil lead data analysis

Surface area-weighted average of lead in soil. The soil lead concentrations only describe a surface area-weighted average of the specific locations where soil was sampled. They do not represent or describe soil lead concentrations throughout the entire exposure unit. The soil sample locations were not randomly selected within the exposure unit; they were convenience samples from parcels where owners provided consent to sample. Therefore, the sample results cannot be statistically extrapolated to unsampled areas within an exposure unit. Details regarding the specific participants/parcels are not provided, to protect the privacy of personal information about individual properties. Lead concentrations found on sampled roads were included within each exposure unit.

Samples were assigned to an exposure unit in an iterative process. First, the townsite was divided into eight equal blocks. All 2017 ISM samples and similar 2016 composite samples of surface soil using a 60-mesh or 80-mesh size were assigned to their corresponding grid. Then, the exposure units were examined to fine-tune the boundaries of each exposure unit, to ensure that samples taken near each other and with similar lead concentrations were assigned to the same exposure unit. The site was ultimately divided into seven exposure units (Figure 5). One contiguous area within the townsite (7-SW) did not have sample data from private property parcels; exposure area 7-SW was only evaluated for lead concentrations within its roadways.

Using GIS shapefiles based on the Lemhi County Assessor data, ATSDR calculated the surface area of the parcel covered by each ISM or composite sample. Shapefiles for 2016 and 2017 sampling were overlaid to identify areas of overlap. In case of overlap, only the 2017 data were used. A weighted average soil concentration was calculated for each exposure unit to adjust for the different surface areas represented by each sample within an exposure unit. Table 6 describes the proportion of total land sampled in each exposure unit along with its surface area-weighted average lead concentration of the sampled area.

Table 6. Exposure unit areas, percent sampled, and surface-area weighted average lead concentration in sampled soil (mg/kg), Gilmore townsite, Idaho.

Exposure Unit (EU)	Total Area (square feet)	Area Sampled (square feet)	Percent Sampled	Surface Area-weighted Average Lead Concentration (mg/kg)*
1-NW (1-Northwest)	1,326,836	269,645	20	13,385
2-NE (2-Northeast)	1,441,397	218,220	15	9,279
3-C (3-Central)	987,377	130,822	13	1,136
4-SE (4-Southeast)	1,103,576	156,003	14	1,643
5-C (5-Central)	1,477,171	361,587	24	635
6-S (6-South)	605,937	213,826	35	161
7-SW (7-Southwest)	870,685	105,785	12	2,303

mg/kg – milligrams lead per kilogram of soil

* Value is the surface area-weighted average of lead in the specific locations where soil was sampled. Value does not represent or describe soil lead concentrations throughout the entire exposure unit.

B.2 IEUBK child blood lead predictions

ATSDR used the integrated exposure uptake biokinetic (IEUBK) model to estimate blood lead levels in children under six years old who are exposed to lead contaminated media. IEUBK estimates a plausible distribution of blood lead concentrations centered on a geometric blood lead concentration for a hypothetical child or population of similarly exposed children. From this distribution, the model estimates the probability that a child's or a population of children's blood lead levels will exceed a target blood lead level.

IEUBK requires a minimum exposure of one day per week for 90 days to reach a steady state concentration in the blood. ATSDR cannot predict blood lead levels to children visiting Gilmore for less than 13 days over a 90-day period.

Soil Exposure Point Concentrations (time-weighted, area-weighted average soil lead for each exposure unit). Using EPA guidance on intermittent exposures [EPA 2003a], the area-weighted averages of surface soil lead concentrations were assessed by the amount of time users are at the site: one day a week, two days a week, or full time for at least 90 days or more (Table 7). These time-weighted surface-area weighted concentrations were used as inputs into the IEUBK and ALM models to predict potential blood lead concentrations in children or women of childbearing age using the site. As recommended, ATSDR adjusted the time weights by 1/7 or 2/7 days at the site with the remaining time at 32.3 mg/kg (Table 7). As many visitors are from Idaho and Utah, ATSDR used USGS data, as the average (95UCL) of soil samples (32.3 mg/kg) collected across Idaho samples (n=131) to cover potential levels throughout the state [Smith et al. 2013]. These time-weighted values were used to estimate adult blood lead levels as well.

In summary, the following equation was used to calculate the time-weighted soil lead concentration:

Time weighted concentration = site surface area-weighted concentration × site frequency per week (1/7 or 2/7) + home soil lead concentration (32 mg/kg) × home frequency (6/7 or 5/7)

Table 7. Time-weighted soil lead concentration (mg/kg) for different exposure scenarios at Gilmore Townsite*

Exposure Unit (EU)	A) Time-weighted soil lead concentration* for 1 day per week for 90 days (mg/kg)	B) Time-weighted soil lead concentration* for 2 days per week for 90 days (mg/kg)	C) Surface area-weighted average lead concentration† for 90 days or more (mg/kg)
1-Northwest (1-NW)	1,940	3,847	13,385
2-Northeast (2-NE)	1,353	2,674	9,279
3-Central (3-C)	190	348	1,136
4-Southeast (4-SE)	262	493	1,643
5-Central (5-C)	118	204	635
6-South (6-S)	51	69	161
7-Southwest (7-SW) †	357	681	2,303

* Time weighted concentration = site surface area-weighted concentration × site frequency per week (1/7 or 2/7) + home soil lead concentration (32 mg/kg) × home frequency (6/7 or 5/7); home soil based on average (95UCL) Idaho soil lead [Smith et al. 2013]

† The surface area-weighted average soil lead concentrations only describe the specific areas where soil was sampled. Since not all parcels were sampled, and samples were not selected randomly, they do not represent or describe soil lead concentrations throughout each exposure unit. See Table 6.

Default values for air, water, dust fraction, and diet were retained. The air data represented only two days of data and may be higher or lower on average, so the default was used (0.1 µg/m^3). The default lead water concentration was used (0.9 µg/L). We do not have enough information about the source of water people are drinking (whether brought to the site or obtained nearby). ATSDR used the recommended methodology in calculating exposures to soil for short residence times [EPA 2003a].

Lead Bioavailability. In 2017, two soil samples were analyzed for *in vitro* bioaccessibility assay of lead [IDEQ/Alta 2022]. The source area sample was a composite of all six 2017 ISM samples from source areas, and the northern townsite sample was a composite of six northern 2017 ISM samples with the highest XRF readings. The calculated relative bioavailability was 55% for both samples, and the absolute bioavailability was 28% and 27% for the source and townsite composite samples, respectively. ATSDR used the default absorption fraction percent (30%) in the IEUBK because of its similarity to that analyzed at the site, and the fact that only some areas were measured.

Results. ATSDR used IEUBK to estimate a plausible distribution of blood lead concentrations centered on the average (geometric mean) blood lead concentration of concern for a hypothetical child or population of similarly exposed children. Table 8 shows younger age groups (6-12, 12-24, and 24-36 months) as more sensitive to having higher blood lead levels, in addition to higher blood lead levels in 1-NW and 1-NE scenarios and staying at the site for ≥ 90 days. Figure 6 and Table 9 show geometric average blood lead levels and percent chance of having a blood lead level above 20, 10, 5, and 3.5 µg/dL for the three exposure scenarios. IEUBK estimates around the CDC BLRV (3.5 µg/dL) and above 30 µg/dL are uncertain as the model is only validated down to 5 µg/dL and up to 30 µg/dL.

Not surprisingly, the probability of a blood lead level above 5 µg/dL increases with the amount of time spent at the site (Table 9; Figure 6). The IEUBK model predicted more than a 5% chance of elevated blood lead levels occurring in a child aged 12-72 months in six of the seven exposure units.

Sampled areas north of Zinc Street in the Gilmore townsite have the greatest potential for exposure and resulted in the highest probability of high child blood lead levels (over 20 µg/dL) with increasing time spent at the site. The IEUBK estimated average (geometric mean) blood lead level by age (Table 8) for a child staying in 1-NW and 2-NE for ≥90d resulted in the highest predicted blood lead levels (23–48 µg/dL). Staying in these areas for 1 or 2d/wk for 90d resulted in average blood lead levels ranging from 5.7–24 µg/dL.

- **1-NW**.
  - **≥5 µg/dL**. All three scenarios predicted a ≥5% chance of a child having a blood lead ≥5 µg/dL for 1d/wk for 90d (95%), 2d/wk for 90d (100%), and staying for ≥90d (100%).
  - **≥10 µg/dL**. All three scenarios resulted in a ≥5% chance of a child having a blood lead ≥10 µg/dL for 1d/wk for 90d (56%), 2d/wk for 90d (88%), and staying for ≥90d (100%).
  - **≥20 µg/dL**. All three scenarios resulted in a ≥5% chance of a child having a blood lead ≥20 µg/dL for 1d/wk for 90d (9.2%), 2d/wk for 90d (38%), and staying for ≥90d (90%).
- **2-NE**.
  - **≥5 µg/dL**. All three scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 µg/dL for 1d/wk for 90d (86%), 2d/wk for 90d (98%), and staying for ≥90d (100%).

- **≥10 μg/dL**. All three scenarios resulted a ≥5% chance of a child having a blood lead ≥10 μg/dL for 1d/wk for 90d (34%), 2d/wk for 90d (74%), and staying for ≥90d (99%).
- **≥20 μg/dL.** Two scenarios resulted in a ≥5% chance of child having a blood lead greater than 20 μg/dL, 2d/wk for 90 days (20%) and for ≥90 days (80%).

Most sampled areas between Gold and Zinc Streets had exposures at 1d/wk for 90d that resulted in child blood lead levels above 5 μg/dL and increased to more than 10 μg/dL with more time spent at the site.

- **4-SE.**
  - **≥5 μg/dL**. All three scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 μg/dL for 1d/wk for 90d (17%), 2d/wk for 90d (50%), and staying for ≥90d (97%).
  - **≥10 μg/dL and ≥20 μg/dL**. Only staying ≥90d resulted in a 5% chance of having a child blood lead ≥10 μg/dL (46%) or ≥20 μg/dL (5.6%).
- **7-SW.**
  - **≥5 μg/dL**. All three scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 μg/dL for 1d/wk for 90d (17%), 2d/wk for 90d (50%), and staying for ≥90d (97%).
  - **≥10 μg/dL.** Two scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 μg/dL, 2d/wk for 90d (6.9%) and ≥90d (66%).
  - **≥20 μg/dL**. Only staying for ≥90d resulted in a ≥5% chance of having a blood lead ≥20 μg/dL (14%).
- **3-C**.
  - **≥5 μg/dL**. Two scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 μg/dL, 2d/wk for 90d (6.9%) and for ≥90d (66%).
  - **≥10 μg/dL**. Only staying for ≥90d resulted in a ≥5% chance of a child having a blood lead ≥10 μg/dL (5.6%).
  - **≥20 μg/dL**. No scenarios resulted in a ≥5% chance of having a blood lead greater than 20 μg/dL.

Between Gold and Copper Streets (5-C), most sampled areas had exposures that resulted in child blood lead levels above 5 μg/dL if visiting or staying for 2d/wk for 90d or more.

- **≥5 μg/dL**. Two scenarios resulted in a ≥5% chance of a child having a blood lead ≥5 μg/dL, 2d/wk for 90d (6.9%) and ≥90d (66%).
- **≥10 μg/dL**. Only staying for ≥90d resulted in a ≥5% chance of having a blood lead ≥10 μg/dL (5.6%).
- **≥20 μg/dL**. No scenarios resulted in a ≥5% chance of having a blood lead greater than 20 μg/dL.

Along the southern part of the site below Copper Street (6-S), none of the exposure scenarios results a 5% chance of having a blood lead greater than 5, 10, or 20 µg/dL.

B.3 Adult blood lead predictions

The Adult Lead Model (ALM) was used to estimate blood lead levels in a non-residential scenario. The model is intended to be used for commercial or industrial workers, but it does provide information on potential harm for non-residents such as temporary residents and visitors to Gilmore [EPA 2003b]. The model's most sensitive individual is the fetus of a non-resident who develops a lead body burden because of exposure to lead. The equations were developed to calculate risk so there is no more than a 5 percent probability that a fetus is exposed to lead at or above 5 µg/dL [Stalcup 2016]. This approach appears to be protective for lead's effect on blood pressure in adult males as well. A soil ingestion rate of 50 mg/day incidental soil ingestion is a central tendency value for non-contact intensive activities. For more contact-intensive activities (such as digging or moving dirt) a greater intake would be expected, closer to 200 mg/day [EPA 2023].

As with the IEUBK, the ALM was not designed to assess exposures less than 90 days. To adjust the model down to one or two days a week for 90 days, ATSDR used the same time-weighted approach to meet the minimum exposure frequency and duration (See Table 6). Residential scenarios up to six months (180 d) were evaluated.

Results. Table 4 (main document) shows the output of the ALM for exposures at the Gilmore townsite. The fetus of a pregnant woman staying in the northern part of the townsite from 180 days (no snow cover) to 2 days per week for 90 days would have an estimated fetal blood lead over 5 µg/dL, which may be harmful to the fetus. The probability of a woman having an estimated fetal blood lead over 20 µg/dL in the northwest (1-NW) exposure unit is 5.1% for 90-day and 30.4% for 180-day exposures. The geometric average adult blood lead in the highest area is predicted to be 8.5 or 16.4 µg/dL, for a 90-day or 180-day exposure, respectively. The full analysis of all exposure scenarios and estimated percent of a fetal blood lead exceeding target level of concern is in Table 10.

Use of an increased soil ingestion rate of 200 mg/day for a constructor moving soil at a property in the northwest exposure unit results in geometric average blood lead levels of 64, 32 and 9.6 µg/dL for these activities over 180 days, 90 days, or 2 days/week for 90 days. The percent chance of an adult moving soil having an estimated fetal blood lead over 20 µg/dL for exposures lasting 180 days, 90 days, or 2 days/week for 90 days in 1-NW exposure unit is predicted to be 96.4%, 73.7% or 5.1%.

Table 8. IEUBK estimated average (geometric mean) blood lead level by age and exposure unit using time-weighted soil concentrations (if applicable).

Exposure Unit	Surface area-weighted* Average Soil Lead Concen-tration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil lead Concen-tration (mg/kg)	Average§ Blood Lead Level ages 6-12 months (µg/dL)	Average§ Blood Lead Level ages 12-24 months (µg/dL)	Average§ Blood Lead Level ages 24-36 months (µg/dL)	Average§ Blood Lead Level ages 36-48 months (µg/dL)	Average§ Blood Lead Level ages 48-60 months (µg/dL)	Average§ Blood Lead Level ages 60-72 months (µg/dL)	Average§ Blood Lead Level ages 72-84 months (µg/dL)
1-Northwest	13,385	1d/wk 90 d	1940	**15.4****	**14.6****	**11.2****	**9.8****	**9.6****	**8.3****	**7.5****
1-Northwest	13,385	2d/wk 90 d	3847	**23.7****	**22.7****	**17.9****	**16.0****	**15.9****	**13.9****	**12.7****
1-Northwest	13,385	≥90 d	-	**48.4**††**	**46.3**††**	**37.6**††**	**34.6**††**	**34.8**††**	**31.6**††**	**29.6****
2-Northeast	9,279	1d/wk 90 d	1353	**12****	**11.4****	**8.6****	**7.5****	**7.3****	**6.3****	**5.7****
2-Northeast	9,279	2d/wk 90 d	2674	**18.9****	**18.1****	**14.0****	**12.4****	**12.2****	**10.6****	**9.6****
2-Northeast	9,279	≥90 d	-	**39.2**††**	**37.8**††**	**30.6**††**	**28.0****	**28.1****	**25.3****	**23.5****
3-Central	1,136	1d/wk 90 d	190	2.9	2.9	2.3	2.1	2.0	1.9	1.7
3-Central	1,136	2d/wk 90 d	348	4.4	4.3	3.3	2.9	2.8	2.5	2.3
3-Central	1,136	≥90 d	-	**10.6****	**10.0****	**7.6****	**6.6****	**6.4****	**5.6****	**5.0****
4-Southeast	1,643	1d/wk 90 d	262	3.6	3.6	2.8	2.5	2.4	2.2	2.0
4-Southeast	1,643	2d/wk 90 d	493	**5.7****	**5.5****	4.2	3.6	3.5	3.1	2.8
4-Southeast	1,643	≥90 d	-	**13.8****	**13.1****	**9.9****	**8.6****	**8.5****	**7.3****	**6.6****

Exposure Unit	Surface area-weighted* Average Soil Lead Concentration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil lead Concentration (mg/kg)	Average§ Blood Lead Level ages 6-12 months (µg/dL)	Average§ Blood Lead Level ages 12-24 months (µg/dL)	Average§ Blood Lead Level ages 24-36 months (µg/dL)	Average§ Blood Lead Level ages 36-48 months (µg/dL)	Average§ Blood Lead Level ages 48-60 months (µg/dL)	Average§ Blood Lead Level ages 60-72 months (µg/dL)	Average§ Blood Lead Level ages 72-84 months (µg/dL)
5-Central	635	1d/wk 90 d	118	2.2	2.3	1.9	1.7	1.7	1.5	1.4
5-Central	635	2d/wk 90 d	204	3.1	3	2.4	2.2	2.1	1.9	1.8
5-Central	635	≥90 d	-	**6.9****	**6.6****	**5.0****	4.3	4.2	3.7	3.3
6-South	161	1d/wk 90 d	51	1.5	1.6	1.4	1.3	1.3	1.3	1.2
6-South	161	2d/wk 90 d	69	1.7	1.8	1.6	1.4	1.4	1.3	1.2
6-South	161	≥90 d	-	2.6	2.7	2.2	1.9	1.9	1.7	1.6
7-Southwest	2,303	1d/wk 90 d	357	4.5	4.4	3.4	2.9	2.9	2.5	2.3
7-Southwest	2,303	2d/wk 90 d	681	**7.3****	**6.9****	**5.2****	4.5	4.4	3.8	3.5
7-Southwest	2,303	≥90 d	-	**17.2****	**16.4****	**12.7****	**11.1****	**10.9****	**9.5****	**8.6****

Abbreviations: BLRV – CDC's Blood Lead Reference Value, CDC – Centers for Disease Control and Prevention, d – day, IEUBK – Integrated Exposure Uptake Biokinetic Model, µg/dL – micrograms lead per deciliter of blood, mg/kg – milligrams lead per kilogram soil, wk – week.

Notes:

* Surface area-weighted average soil lead concentrations only describe the specific areas where soil was sampled. Since not all parcels were sampled, they do not represent or describe soil lead concentrations throughout each exposure unit. See Table 6.

† Time weighted concentration = site surface area-weighted concentration × site frequency, see Table 7. Model is not validated for soil lead concentrations above 5,000 mg/kg; blood lead predictions for higher soil lead concentrations may be overestimated.

§ Geometric Mean

** Greater or equal to 5 µg/dL (validated IEUBK target level of concern), values **bolded** for effect

†† IEUBK is not validated for use in estimating blood lead levels over 30 µg/dL and may not accurately reflect estimates over 30 µg/dL.

Table 9. IEUBK-estimated average (geometric mean) child (12-72 months old) blood lead level and percent chance that a child blood lead exceeds various target levels (3.5, 5.0, 10, and 20 µg/dL) by exposure unit using time-weighted soil concentrations (if applicable).

Exposure Unit	Surface area-weighted* Average Soil Lead Concentration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil Lead Concentration (mg/kg)	Average §,# blood lead of children 12-72 months	Percent chance# that blood lead > 3.5 µg/dL (%)	Percent chance that blood lead > 5 µg/dL (%)	Percent chance that blood lead > 10 µg/dL (%)	Percent chance that blood lead > 20 µg/dL (%)
1-Northwest	13,385	1d/wk 90 d	1,940	**10.7**	**99****	**95****	**56****	**9.2****
1-Northwest	13,385	2d/wk 90 d	3,847	**17.3**	**100****	**100****	**88****	**38****
1-Northwest	13,385	≥90 d	-	**37.0**	**100****	**100****	**100****	**90****
2-Northeast	9,279	1d/wk 90 d	1,353	**8.2**	**97****	**86****	**34****	2.9
2-Northeast	9,279	2d/wk 90 d	2,674	**13.5**	**100****	**98****	**74****	**20****
2-Northeast	9,279	≥90 d	-	**29.9**	**100****	**100****	**99****	**80****
3-Central	1,136	1d/wk 90 d	190	2.3	**17****	4.4	< 1.0	< 1.0
3-Central	1,136	2d/wk 90 d	348	3.2	**42****	**17****	< 1.0	< 1.0
3-Central	1,136	≥90 d	-	**7.2**	**94****	**78****	**25****	1.5
4-Southeast	1,643	1d/wk 90 d	262	2. 7	**28****	**9.1****	< 1.0	< 1.0
4-Southeast	1,643	2d/wk 90 d	493	4.0	**61****	**31****	2.5	< 1.0
4-Southeast	1,643	≥90 d	-	**9.5**	**98****	**91****	**46****	**5.6****
5-Central	635	1d/wk 90 d	118	1.8	**8.1****	1.5	< 1.0	< 1.0

Exposure Unit	Surface area-weighted* Average Soil Lead Concentration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil Lead Concentration (mg/kg)	Average §,# blood lead of children 12-72 months	Percent chance# that blood lead > 3.5 µg/dL (%)	Percent chance that blood lead > 5 µg/dL (%)	Percent chance that blood lead > 10 µg/dL (%)	Percent chance that blood lead > 20 µg/dL (%)
5-Central	635	2d/wk 90 d	204	2.3	**19****	**5.2****	< 1.0	< 1.0
5-Central	635	≥90 d	-	4.7	**74****	**45****	**5.6****	< 1.0
6-South	161	1d/wk 90 d	51	1.4	2.6	< 1.0	< 1.0	< 1.0
6-South	161	2d/wk 90 d	69	1.5	3.7	< 1.0	< 1.0	< 1.0
6-South	161	≥90 d	-	2.1	**13****	3.1	< 1.0	< 1.0
7-Southwest	2,303	1d/wk 90 d	357	3.2	**43****	**17****	< 1.0	< 1.0
7-Southwest	2,303	2d/wk 90 d	681	**5.0**	**77****	**50****	**6.9****	< 1.0
7-Southwest	2,303	≥90 d	-	**12.1**	**100****	**97****	**66****	**14****

Abbreviations: BLRV – CDC's Blood Lead Reference Value, CDC – Centers for Disease Control and Prevention, d – day, IEUBK – Integrated Exposure Uptake Biokinetic Model, µg/dL – micrograms lead per deciliter of blood, mg/kg – milligrams lead per kilogram soil, wk – week

Notes:

* Surface area-weighted average soil lead concentrations only describe the specific areas where soil was sampled. Since not all parcels were sampled, they do not represent or describe soil lead concentrations throughout each exposure unit. See Table 6.

† Time-weighted concentration = site surface area-weighted concentration × site frequency, see Table 7. Model is not validated for soil lead concentrations above 5,000 mg/kg; blood lead predictions for higher soil lead concentrations may be overestimated.

§ Geometric Mean

Most children in the US (97.5%) have blood lead levels below the CDC blood lead reference value (3.5 µg/dL); however, IEUBK is not validated for use in estimating blood lead levels under 5 µg/dL or over 30 µg/dL and may not accurately reflect estimates under 5 µg/dL and above 30 µg/dL.

** Greater or equal to 5 percent chance that blood lead exceeds target level of concern, values **bolded** for effect.

Table 10. Adult estimated geometric mean blood lead level (BLL) and probability that fetal blood is greater than target BLLs of concern using time-weighted soil concentrations when applicable, Gilmore, Idaho.

Exposure Unit	Surface area-weighted* Average Soil Lead Concentration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil Lead Concentration (mg/kg)	Average §,# blood lead of adult non-resident	Probability of fetal blood lead# ≥ 3.5 µg/dL (%)	Probability of fetal blood lead ≥ 5 µg/dL (%)	Probability of fetal blood lead ≥ 10 µg/dL (%)	Probability that fetal blood lead ≥ 20 µg/dL (%)
1-NW	13,385	1d/wk 90 d	1,940	1.7	**8.7****	2.5	< 1.0	-
1-NW	13,385	2d/wk 90 d	3,847	2.9	**30.4****	**13.1****	1.1	-
1-NW	13,385	≥90 d	-	**8.5**	**90.9****	**76.7****	**32.6****	**5.1****
1-NW	13,385	≥180 d	-	**16.4**	**99.3****	**96.8****	**74.8****	**30.4****
2-NE	9,279	1d/wk 90 d	1,353	1.4	4.1	1.0	-	-
2-NE	9,279	2d/wk 90 d	2,674	2.2	**16.3****	**5.6****	< 1.0	-
2-NE	9,279	≥90 d	-	**6.1**	**77.7****	**56.2****	**6.1****	1.4
2-NE	9,279	≥180 d	-	**11.6**	**96.8****	**89.4****	**42.8****	**13.4****
3-C	1,136	1d/wk 90 d	190	0.7	< 1.0	-	-	-
3-C	1,136	2d/wk 90 d	348	0.8	< 1.0	< 1.0	-	
3-C	1,136	≥90 d	-	1.3	2.9	< 1.0	-	-
3-C	1,136	≥180 d	-	1.9	**11.9****	3.7	< 1.0	-
4-SE	1,643	1d/wk 90 d	262	0.8	< 1.0	-	-	-
4-SE	1,643	2d/wk 90 d	493	0.9	< 1.0	< 1.0	-	
4-SE	1,643	≥90 d	-	1.6	**6.2****	1.6	-	-
4-SE	1,643	≥180 d	-	2.5	**23.5****	**9.2****	< 1.0	-
5-C	635	1d/wk 90 d	118	0.7	< 1.0	-	-	-
5-C	635	2d/wk 90 d	204	0.7	< 1.0	-	-	-
5-C	635	≥90 d	-	1.0	< 1.0	< 1.0	-	-
5-C	635	≥180 d	-	1.4	3.6	< 1.0	-	-
6-S	161	1d/wk 90 d	51	0.6	< 1.0	-	-	-
6-S	161	2d/wk 90 d	69	0.6	< 1.0	-	-	-

Exposure Unit	Surface area-weighted* Average Soil Lead Concentration (mg/kg)	Scenario Frequency	Time-weighted† Average Soil Lead Concentration (mg/kg)	Average §,# blood lead of adult non-resident	Probability of fetal blood lead# ≥ 3.5 µg/dL (%)	Probability of fetal blood lead ≥ 5 µg/dL (%)	Probability of fetal blood lead ≥ 10 µg/dL (%)	Probability that fetal blood lead ≥ 20 µg/dL (%)
6-S	161	≥90 d	-	0.7	< 1.0	-	-	-
6-S	161	≥180 d	-	0.8	< 1.0	-	-	-
7-SW	2,303	1d/wk 90 d	357	0.8	< 1.0	<1.0	-	-
7-SW	2,303	2d/wk 90 d	681	1.0	1.1	< 1.0	-	-
7-SW	2,303	≥90 d	-	2.0	**12.2****	3.8	< 1.0	-
7-SW	2,303	≥180 d	-	3.3	**39.5****	**19.1****	2.0	< 1.0

Abbreviations: C – central, d – day, IEUBK – Integrated Exposure Uptake Biokinetic Model, µg/dL – micrograms lead per deciliter of blood, mg/kg – milligrams lead per kilogram soil, NE – northeast, NW – northwest, S – south, SE – southeast, SW – southwest, wk – week, ≥ - greater than or equal to, "-" zero probability of occurring

Notes:

* Surface area-weighted average soil lead concentrations only describe the specific areas where soil was sampled. Since not all parcels were sampled, they do not represent or describe soil lead concentrations throughout each exposure unit. See Table 6.

† Time weighted concentration = site surface area-weighted concentration × site frequency at site and at home, see Table 7. Model is not validated for soil lead concentrations above 5,000 mg/kg; blood lead predictions for higher soil lead concentrations may be overestimated.

§ Geometric Mean.

The Adult Lead Model is not validated for use in estimating blood lead levels under 5 µg/dL or over 30 µg/dL and may not accurately reflect estimates under 5 µg/dL and above 30 µg/dL; therefore, uncertainty associated with interpreting percent chance for 3.5 µg/dL target level of concern

** Greater or equal to 5 percent chance that blood lead exceeds target level of concern, values **bolded** for effect.

Appendix C - State of Idaho Fact Sheet on Activities to Reduce Exposures

In addition to medical intervention through blood testing, a fact sheet on preventing exposures can be found and downloaded at https://www2.deq.idaho.gov/admin/LEIA/api/document/download/16858.

ATTENTION

High levels of lead and arsenic are present in soil and dust at and near the Gilmore townsite and can be very harmful to your health.

Be Safe. Protect Your Health and Your Family's Health.

Children, pregnant women, and women of childbearing age are most at risk and need to avoid exposure.

How can I reduce exposures to metals at Gilmore?
Lead, arsenic, and other metals can enter your body by breathing in (inhaling) or swallowing (ingesting) contaminated dust or soil. Exposure to lead, arsenic, and other metals will be difficult to avoid at and near the Gilmore townsite, especially during activities such as playing, eating, working, riding bikes or ATVs. Limiting the amount of time in the area or avoiding intense exposure can reduce but not eliminate exposure.

When children are present:

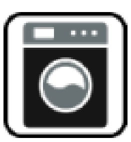
- Do not allow children to dig or play in the dirt (e.g., bare soil, muddy areas, mine waste piles).
- Frequently bathe children. If water is not available, wash children with a damp cloth or wet wipes.
- Regularly clean toys, pacifiers, and other items that children put into their mouths.
- Avoid interaction between children and dirty, dusty pets.

When recreating:

- Go slowly. Do not create dust. Follow others at a safe riding distance. Avoid breathing dust.
- Wash hands with soap and water or wipes before eating, drinking, or smoking.
- Avoid disturbing mine waste piles and all other soil throughout the area.
- Eat on a clean table or blanket, not on the ground. Do not eat food that has fallen on the ground.

When staying:

- Avoid tracking dirt inside by removing shoes and dusty clothing before entering.
- Wash or wipe paws and fur of pets before allowing them inside homes or vehicles.
- Wash hands often, especially after outdoor activities and before eating, drinking, and smoking.
- Regularly mop floors and damp-wipe indoor surfaces, such as table and countertops.
- Keep windows and doors closed on windy days.
- Store dirty laundry in garbage bags to wash separately later.



When returning home:

- Remove shoes and wash dirty, dusty clothes separately from other laundry.
- Bathe pets before allowing them to enter your home.
- Wash or use a damp cloth to wipe off camping gear, recreational equipment, and toys.
- Wash vehicles and ATVs to avoid tracking contaminated soil into your garage and home.

For additional information, visit **www.deq.idaho.gov/gilmore** or call the Idaho Department of Health and Welfare at 1-800-445-8647

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

IDAHO DEPARTMENT OF
HEALTH & WELFARE
DIVISION OF PUBLIC HEALTH

Appendix D - Brief Summary of ATSDR's Public Health Assessment (PHA) Process

ATSDR follows the PHA process to find out:

- Whether people living near a hazardous waste site are being exposed to toxic substances.
- Whether that exposure is harmful.
- What must be done to stop or reduce exposure.

The PHA process is a step-by-step consistent approach during which ATSDR:

- Establishes communication mechanisms, including engaging communities at the beginning of site activities and involves them throughout the process to respond to their health concerns.
- Collects many different kinds of site information.
- Obtains, compiles, and evaluates the usability and quality of environmental and biological sampling data (and sometimes modeling data) to examine environmental contamination at a site.
- Conducts four main, sequential scientific evaluations.
    - Exposure pathways evaluation to identify past, present, and future site-specific exposure situations, and categorize them as completed, potential, or eliminated.
    - Screening analysis to compare the available sampling data to media-specific environmental screening levels (ATSDR comparison values [CVs] and non-ATSDR screening levels). This identifies potential contaminants of concern that require further evaluation for completed and potential exposure pathways.
    - Exposure Point Concentrations (EPCs) and exposure calculations for contaminants flagged as requiring further evaluation in completed and potential exposure pathways. It involves calculating EPCs, using the estimated EPCs to perform exposure calculations, and determining which site-specific scenarios requires an in-depth toxicological effects analysis.
    - In-depth toxicological effects evaluation, if necessary, based on the three previous scientific evaluations. This step looks more closely at contaminant-specific information in the context of site exposures. This evaluation can also help determine if there is a potential for non-cancer or cancer health effects.
- Summarizes findings and next steps, while acknowledging uncertainties and limitations.
- Provides recommendations to site-related entities, partner agencies, and communities to prevent and minimize harmful exposures.

The sequence of steps can differ based on site-specific factors. For instance, health assessors might define an exposure unit before or after the screening analysis.

For more detail on the PHA process, please visit Explanation of ATSDR's PHA Process Evaluation. Readers can also refer to ATSDR's Public Health Assessment Guidance Manual for all information related to the stepwise PHA process.