Public Health Assessment

Bautsch-Gray Mine
Jo Daviess County, Illinois

Evaluation of Metals in Mine Tailings, Soil, Sediment, and Surface Water

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Public Health Assessment: A Note of Explanation

This Public Health Assessment - Initial Draft was prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

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Acronyms and Abbreviations

95UCL	95 Percent Upper Confidence Limit
AALM	All-Ages Lead Model
ATSDR	Agency For Toxic Substances and Disease Registry
BLL	Blood Lead Level
BLRV	Blood Lead Reference Value
BGS	Below The Ground Surface
CDC	Centers For Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act Of 1980
COCs	Contaminants Of Concern
CR	Cancer Risk
CSF	Cancer Slope Factor
CTE	Central Tendency Exposure
CV	Comparison Value
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
GRASP	Geospatial Research, Analysis, And Services Program
HQ	Hazard Quotient
IA	Integrated Assessment
IDPH	Illinois Department of Public Health
IEPA	The Illinois Environmental Protection Agency
IEUBK	Integrated Exposure Uptake Biokinetic
LEPAC	Lead Exposure Prevention Advisory Committee
LOAEL	Lowest Observed Adverse Effect Level
mg/day	Milligrams Per Day
mg/kg	Milligrams Per Kilogram
mg/kg/day	Milligrams Per Kilogram Per Day
MRLs	Minimal Risk Levels
NHANES	National Health and Nutrition Examination Survey
NOAEL	No Observable Adverse Effect Level

NPL	National Priorities List
PHA	Public Health Assessment
PHAST	Public Health Site Assessment Tool
PM	Particulate Matter
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RSLs	Regional Screening Levels
SA	Site Assessment
XRF	X-Ray Fluorescence
µg/L	Micrograms Per Liter
µg/m3	Micrograms Per Cubic Meter
µg/dL	Micrograms Per Deciliter

1. Summary

1.1 Introduction

The Bautsch-Gray Mine Site (the Site) consists of an abandoned lead and zinc mining and milling operation located approximately 4 miles to the southeast of Galena, in the rural area of Jo Daviess County, Illinois. Mining and milling operations were conducted at the Site from 1927 to 1979, producing large amounts of mine tailings which were deposited over approximately 43 acres and eventually eroded off-site. Tailings from the Site have affected the surrounding wooded properties, a former settling pond (referred to in this report as the "horseshoe settling pond"), an overland flow route, Smallpox Creek, and one residential property directly to the west of the tailings pile (referred to in this report as "the residential property"). The Illinois Environmental Protection Agency (IEPA) and United States Environmental Protection Agency (EPA) contractors have collected data throughout the Site and areas of concern over the course of multiple environmental investigations. These data show concentrations of lead, arsenic, cadmium, manganese, and zinc in various media exceeding media-specific screening levels developed by the Agency for Toxic Substances and Disease Registry (ATSDR) along with other applicable screening values. There are multiple exposure pathways through multiple media for past, present, and future scenarios. The exposure groups include owners of the surrounding wooded properties who use the Site for recreation and hunting (referred to in this report as "property owners"), as well as trespassers, workers, anglers, and residents of the residential property. The Site is currently unoccupied, not regularly accessed, and is in a sparsely populated area.

On September 18, 2012, EPA added the Bautsch-Gray Mine Site, Jo Daviess County, Illinois, to the National Priorities List (NPL) of hazardous waste sites. The Illinois Department of Public Health (IDPH), in cooperation with ATSDR, prepared the following public health assessment (PHA) to evaluate the public health implications of potential exposures to contaminants found at the Site to provide people living around the Site with the best information possible to safeguard their health.

1.2 Conclusions

Based on the data available for review by IDPH and ATSDR, there are completed exposure pathways for soil and indoor dust ingestion, dermal soil absorption, dust inhalation, and fish consumption. There are also potential exposure pathways for drinking water ingestion, incidental soil, sediment, and surface water ingestion, and dust inhalation. IDPH and ATSDR have reached the following conclusions in this PHA.

Conclusion 1 *Exposure to lead in soil or mine tailings at the tailings pile, surrounding wooded properties, and horseshoe settling pond and overland flow route may pose a past, present, and future health hazard to property owners, hunters, and trespassers who access* *these areas* frequently. *IDPH concludes that children under the age of 11 years are not likely to be exposed because they are unlikely to access these remote areas and terrain.*

Basis for Conclusion

Lead modeling indicated a greater than 5% chance that exposures to lead in soil and tailings would cause blood lead levels (BLLs) in adult males at the tailings pile, surrounding wooded properties, and horseshoe settling pond and overland flow route, and adult females at the tailings pile to exceed the target BLL used by IDPH (see Section 7.1). These exceedances increase the likelihood of harmful health effects from lead exposure. The nervous system is the main target for adverse effects of lead in adults. Long-term exposure can result in decreased learning, memory, and attention. It can also increase blood pressure, particularly in middle-aged and older individuals, and cause hardening of the arteries known as arteriosclerosis, which reduces blood flow to organs, including the heart. Lead exposure can cause changes in enzyme activity in the blood, resulting in decreased hemoglobin and platelet counts and may result in anemia (reduced red blood cells). Lead exposure also can damage the kidneys, resulting in protein in the urine, and alter the immune system reducing the body's ability to fight off infections.

Next Steps

IDPH recommends those who access the tailings pile and surrounding wooded properties consider the following best practices for reducing exposure to contaminated soil tracked indoors:

- Remove shoes when you go inside and leave outdoor shoes in the garage or the entryway. Separately wash heavily soiled clothes.
- Vacuum carpeting, rugs, and upholstery often to keep dust from accumulating. Wet mop and wet wipe surfaces in the home, especially in areas where children play.

IDPH recommends that those known to access these areas discuss blood lead testing with their health care provider.

Additionally, EPA may consider posting additional signage which alerts individuals of the present contamination and associated harmful health effects that could result from exposure. EPA is also encouraged to continue to stop or reduce exposure to lead in the tailings pile.

Conclusion 2

Past exposure to lead in soil, indoor dust, and tailings may have harmed the health of children and adults at the residential property.

Basis for Conclusion	Evidence shows that the soil at the residential property was contaminated with lead when heavy rains caused erosion and runoff from the tailings pile in the East Area. The property may have been contaminated as far back as 1970. Modeling indicated a greater than 5% chance that exposures to lead in soil at various concentrations detected at the residential property could have caused or could cause blood lead concentrations in children and adult males to exceed the target blood lead concentration used by IDPH (see Section 7.1). This exceedance increased the likelihood of harmful effects in children and adult males who lived at the residence. Children are the most at risk of adverse health effects from lead exposure and no safe level of lead exposure has been identified. Lead exposure can cause well-documented seriously adverse effects in children, such as: • Damage to the brain and nervous system • Slowed growth and development • Learning and behavior problems • Hearing and speech problems Effects of lead exposure can include reduced intelligence, decreased ability to pay attention, and underperformance in school. These exceedances of the target BLL also increase the likelihood of the harmful health effects for adults which were detailed in the Conclusion 1.
Next Steps	IDPH recommends that the owner of the residential property to contact EPA if mine tailings overflow onto the property again in the future. They may also consider the following steps to reduce their exposure to soil contaminants: • Wear gloves when working with soil and wash hands before eating or drinking. • Wash all produce grown in the garden using running water. Discard the outer leaves of greens before washing. Peel root vegetables that were in direct contact with soil. • Cover bare dirt patches with mulch, grass, or other ground cover. • Vacuum carpeting, rugs, and upholstery often to keep dust from accumulating. Wet mop and wet wipe surfaces in the home, especially in areas where children play.

- Remove shoes when you go inside and leave outdoor shoes in the garage or the entryway. Separately wash heavily soiled clothes.

Future residents may also consider discussing blood lead testing for children with their healthcare provider should any erosion events occur, and if they come in regular contact with the tailings.

Conclusion 3	*Exposure to arsenic at the residential property, tailings pile, and surrounding wooded properties could result in increased cancer risks.*
Basis for Conclusion	IDPH estimated cancer risks for children and adults who are exposed to arsenic at the residential property (used as a primary residence), tailings pile, and surrounding wooded properties which were at or above 1 in 10,000. IDPH considers theoretical cancer risks at or above 1 in 10,000 to be an indication of increased chances for cancers for those exposed.
Next Steps	IDPH will provide health education on reducing exposure to soil contaminants to those living near the tailings pile and surrounding wooded properties.
Conclusion 4	*Future exposure to arsenic or manganese in soil could affect the health of children living at the residential property.*
Basis for Conclusion	One sample on the residential property had an arsenic concentration slightly above the background concentration in Jo Daviess county. Estimated doses exceeded the lowest observed adverse effect levels (LOAELs) from human exposure studies which showed an association between arsenic exposure and increased instances of ischemic heart disease and diabetes. The exceedance of the LOAELs indicates a possible increased risk of these adverse health effects for future children living at the residential property. However, it is unclear how accurate these doses are for characterizing health risks because they are based on one sample. With these limitations in mind, the dose was used as a conservative measure to protect human health. One soil sample on the residential property had a manganese concentration that would result in a dose that exceeds the LOAEL from a study of children exposed to high levels of manganese in drinking water. Regular exposure to this manganese concentration could be harmful to young children.

	This sample, however, was located on the edge of the property near the highway and young children are not likely to play in this area. In addition, the bioavailability of manganese in this soil is unknown, so it is unclear how accurate this dose is for characterizing health risks. With these limitations in mind, the dose was used as a conservative measure to protect human health.
Next Steps	No children currently live at the residential property, so no further action is recommended for the residents at this time. IDPH recommends EPA consider additional surface soil sampling on the residential property to characterize manganese concentrations more accurately. IDPH will reevaluate future exposure to manganese in soil if additional soil data become available.
Conclusion 5	*Exposure to sediment and surface water contamination in Smallpox Creek does not pose a health hazard to people using the creek for wading or fishing.*
Basis for Conclusion	There are sediment and surface water sampling data for the creek. However, it is a small, low-flow creek which is not expected to be used frequently for recreational use. As such, there have not been reports of people using the creek for swimming, canoeing, wading, or other instream recreation. Nevertheless, exposure modeling was conducted to assess past reports of fishing and potential present and future access to the creek as a conservative measure. All estimates of exposure produced results which indicated adverse health effects were not likely.
Next Steps	No future action is recommended.
Conclusion 6	*Ingestion and dermal contact with cadmium and zinc in East Area and West Area soil and tailings is not expected to pose a noncancer health hazard to any exposure group.*
Basis for Conclusion	Estimated doses for all exposure groups considered in this assessment are below levels which are expected to cause harmful noncancer health effects.
Next Steps	While exposure to cadmium and zinc does not pose a hazard for noncancer health effects, arsenic poses increased risks of cancer health effects. Therefore, those who access the tailings pile and surrounding wooded properties should follow the steps in Conclusion 1 to reduce exposure to soil contamination.

Conclusion 7	*There is not enough information for IDPH to determine if windblown dust from the Bautsch-Gray Mine Site could have harmed people's health in the East Area or West Area in the past.*
Basis for Conclusion	While exposures might have occurred, there are insufficient data to assess possible health effects. EPA did limited dust sampling during remedial activities and did not detect contaminants above levels of concern. However, samples were collected during times when dust sampling was not ideal (e.g., after rainfall) and limited samples were taken during other sampling events during dry weather conditions.
Next Steps	IDPH recommends that EPA conduct air sampling for particulate matter and airborne lead during any future remedial work on the Site and share those results with IDPH.
Conclusion 8	*There is not enough information for IDPH to determine if past fish consumption could have harmed the health of anglers.*
Basis for Conclusion	The available fish tissue sampling data are insufficient in both quantity and quality. Therefore, the data could not be used to assess exposure reliably. IDPH believes this is not a complete pathway for present or future anglers because the creek does not appear to produce enough fish of edible size to provide regular meals.
Next Steps	No further action is necessary. Anglers are encouraged to become familiar with and follow the Illinois Fish Consumption Advisories for other contaminants. The statewide mercury advisory is 1 meal per week unless a more restrictive site-specific advisory has been established.
Conclusion 9	*There is not enough information for IDPH to determine if groundwater could have harmed the health of the residents at the residential property.*
Basis for Conclusion	Current residents refrained from using the well water since moving into the property in 1993. Residents prior to 1993, particularly those who initially had the well drilled, are expected to have used the water. However, IDPH has no information to confirm this and has no pre-1993 data to assess past exposures.
Next Steps	A new well was drilled and a reverse osmosis water treatment

	system was installed on the property in 2022. Lead was not detected in either pre- or post-treatment confirmation sampling. IDPH recommends the residents maintain the water treatment system properly to minimize lead exposures as much as possible.
Conclusion 10	*There is not enough information for IDPH to determine if mine tailings hauled off site and used for driveways and fill could pose a health hazard to exposed individuals.*
Basis for Conclusion	Community members expressed this concern during a meeting held by EPA in 2010. Without knowing when, where, or how the mine tailings were used, and lacking sample data to evaluate, it is not possible to assess the risk.
Next Steps	IDPH recommends that residents cover or remove these materials where they are known to exist.
For More Information	**Public Comment Period:** This document will have a 60-day public comment period which provides an opportunity for the public to comment on the findings contained in this document. Questions and comments about this Public Health Assessment should be directed to the IDPH Toxicology Section.at DPH.Tox@illinois.gov or 217-782-5830.

2. Statement of Issues

The Bautsch-Gray Mine is an abandoned lead and zinc mining and milling operation located approximately 4 miles to the southeast of Galena, Illinois, in a rural area of Jo Daviess County, Illinois. The Site was proposed for the NPL on March 15, 2012, based on several environmental investigations, which identified metals contamination of soil, groundwater, and sediment and surface water in the nearby Smallpox Creek.

On September 18, 2012, EPA listed the Site on the NPL. Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986, ATSDR is required to assess potential public health impacts for sites listed or proposed to the NPL. IDPH, in cooperation with ATSDR, prepared the following PHA to review environmental data obtained from the Site, evaluate potential human exposure to contaminants, and determine whether the exposures are of public health concern.

3. Background

3.1 Site Description and Operational History

The Bautsch-Gray Mine (the Site) is an abandoned lead and zinc mining and milling operation located approximately 4 miles to the southeast of Galena, Illinois and approximately 1.5 miles east of the Mississippi river in a rural area of Jo Daviess County, Illinois. The Bautsch and Gray Mines were two separate underground slope mines. The Gray Mine began operating in 1927 and continued until the 1940's. The Bautsch Mine began operating in 1946 and continued until 1979. No mining activities have occurred on the property since 1979. A mill formerly on the Site processed rock from both mines to separate usable lead and zinc ore. The leftover rock, known as mine tailings, began to accumulate on the Site as the mines operated (IEPA, 2001).

The public and local municipalities are reported to have used the mine tailings for fill, roadways, and driveways, but the extent of this use is not known. The former mine is also reported to have been used for recreational activity (IEPA, 2001). Access to the mine tailings had been unrestricted since the mine closed in 1979. Access remains unrestricted with some "no trespassing" signs posted along the perimeter of the tailings pile (SulTRAC, 2016).

For this assessment, IDPH organized the Site into two separate "Areas": East and West. These two Areas are divided by Blackjack Road, with each Area lying in its respective direction from Blackjack Road **(Figure 1, Appendix B)**. Within each Area are discrete exposure units which will be discussed independently of one another. The East Area is comprised of two exposure units: the tailings pile and the surrounding wooded properties. The West Area contains three exposure units: the residential property, horseshoe settling pond and overland flow route, and Smallpox Creek.

East Area Description

This Area is composed of approximately 43 acres of mine tailings excavated from Bautsch-Gray Mine, which is bordered by approximately 12 acres of wooded properties to the north, east, and south. These are located east of Blackjack Road and consists of three different parcels owned by local residents (Weston Solutions Inc, 2010).

West Area Description

This Area is approximately 22 acres consisting of a residential property directly across the road from the tailings pile, horseshoe settling pond and overland flow route, and Smallpox Creek. The West Area historically received the major portion of the surface water runoff from the tailings pile, before landscaping remedial activities and installation of a retention pond on the tailings pile sometime in 2012 redirected the runoff (EPA, 2012a). Prior to remediation, excess surface water with eroded mine tailings were channeled through a drainage tube under Blackjack Road into the settling pond. The construction of a makeshift dam formed the horseshoe settling pond, which was approximately 5 acres in size with mine tailings estimated to be 4 to 20 feet thick. From the horseshoe settling pond, surface water migrated along an overland flow route of approximately 1,100 feet to the Smallpox Creek (Weston Solutions, Inc, 2010). During heavy rain events, additional flow routes were formed that directed surface water and mine tailings from the tailings pile onto the residential property. (Weston Solutions, Inc, 2010).

The residential property is occupied and consists of a 5-acre parcel located approximately 150 feet to the west of the tailings pile. This property contains a private well that was originally drilled at a similar depth to lead ore bearing formations in the area (SulTRAC, 2016). There have been two separate, major precipitation events which caused tailings to migrate from the tailings pile across Blackjack Road to the residential property. There is additional evidence that mine tailings have been washing onto the property as far back as 1970 (IEPA, 2002).

Smallpox Creek is a small stream, which flows into the Mississippi River near a location designated as the Upper Mississippi River Wildlife and Fish Refuge. The area of interest for Smallpox Creek begins directly west of the horseshoe settling pond and continues southwest to the backwater area of the Mississippi River **(Figure 1, Appendix B)**.

3.2 Regulatory and Remedial History

In June 1999, a complaint filed with the Illinois Environmental Protection Agency (IEPA) stated that the Site was open to the public and they were possibly using the mine tailings for fill in driveways in Galena. In July 1999, IEPA conducted a preliminary investigation of the Site and observed heavy equipment for loading the mine tailings. The owners of the equipment were immediately notified that the tailings were not to be used. IEPA issued a press release in May 2000 advising the public of the hazards of using the mine tailings (IEPA, 2001).

IEPA conducted an integrated assessment (IA) and expanded site inspection in 2000 and 2001, respectively. These were part of pre- CERCLA site investigation activities. These investigations confirmed that the mine tailings contained elevated levels of arsenic, lead, zinc, and other heavy metals. In addition, these investigations documented that mine tailings were possibly impacting groundwater in the West Area. A water sample collected from the well at the residential property indicated levels of lead, which exceeded the action level of 15 micrograms per liter (µg/L) used by EPA at the time. IDPH notified the resident of these findings and advised them to use an alternate source of water for drinking and cooking (IEPA, 2001).

In August 2009, a heavy rainfall event resulted in mine tailings running off from the tailings pile and migrating over Blackjack Road onto the residential property. IEPA was notified of the situation by the Jo Daviess County Highway Department. This prompted an investigation during which IEPA collected samples from the waste piles, roadway ditches, Blackjack Road, and the residential property. The results indicated that elevated levels of lead, arsenic, and cadmium were present in the materials washed from the tailings pile. In response to these results, IEPA submitted a referral letter in September 2009 to EPA for a time-critical removal action (Weston Solutions, Inc, 2010).

In October 2009, Weston Solutions, Inc. Superfund Technical Assessment and Response Team assisted EPA in performing a site assessment (SA) at the Bautsch-Gray Mine Site. The objective of the site assessment was to evaluate the magnitude and extent of contamination in soil, surface water, groundwater, and mine tailings to determine if the Site posed a threat to human health and the environment. Sampling activities included three private water wells, surface water, soil, and mine tailing samples (Weston Solutions, Inc, 2010). Private well sampling results at the residential property in the West Area showed lead concentrations which exceeded EPA's action level for lead of 15 µg/L. Concentrations of all analytes were within acceptable levels at the other sampled wells, which are located directly south of the Site.

In response to the site assessment, EPA began time-critical removal action activities in the fall of 2010 and this work was completed in 2011.

Remedial activities predominantly in the West Area included:

- Removal of mine tailings and contaminated soil (with lead levels over 400 milligrams per kilogram (mg/kg)), which was EPA's clean-up level for lead at the time of remediation) from the residential property and replacing it with clean soil; including a removal following a heavy rain event in 2011, which caused another erosion of tailings.
- Removal of mine tailings from some adjacent road ditches along Blackjack Road.
- Installation of a whole house reverse osmosis water treatment system at the residential property with the contaminated well.
- Repair of the horseshoe settling pond dam.
- Planting grass on the horseshoe settling pond to reduce erosion.
- Grading and contouring parts of the tailings pile to ensure proper stormwater drainage.
- Installation of retention ponds to prevent mine tailings from migrating offsite.
- Planting grass on a portion of the mine tailings on the east side of the Blackjack Road to reduce erosion.

In May and November of 2014, the EPA contractor SulTRAC completed both Phase I and II of a remedial investigation (RI) for the Site. The purpose of this remedial investigation was to further define the nature and extent of tailings pile contamination of nearby properties, surface water, sediment, and groundwater; evaluate human health and ecological risks posed by the contamination; and evaluate additional remediation options. Sampling activities included mine tailings, soil, sediment, surface water, and fish tissue samples throughout the entire Site except for the tailings pile and the West Area residential property. Sampling results identified arsenic, lead, cadmium, zinc, and manganese as potential contaminants of concern (COCs).

EPA has continued site inspections and maintenance as of the preparation of this document. Since 2018, the following additional remedial work has been completed:

- Retention pond maintenance in the West Area
- Regrading in key areas on the tailings pile in the East Area
- Application of soil stabilizer/dust suppressant on the tailings pile in the East Area

3.3 Site Geology and Hydrogeology

The aquifer for the Site is the Galena-Platteville formation, which immediately underlies the unconsolidated overburden soils at the surface. This shallow aquifer begins between 0 and 60 feet below the ground surface (bgs) and is approximately 225 to 344 feet thick. It is the aquifer most of the private wells in the area draw their water from. There is also a lead ore deposit in this area **(Figure 2, Appendix B),** which extends from approximately 25 to 175 bgs (SulTRAC, 2016). This lead ore deposit overlaps with the shallow aquifer in the area and may have caused the increased lead concentrations in the West Area residential property's previous well. Additionally, the fractured nature of the Galena-Platteville formation allows a downward migration of any hazardous substances released on the surface to penetrate the aquifer, which could potentially impact private wells. Based on topography, it is likely that the groundwater flow in the area is to the west towards the Mississippi River (EPA, 2010).

There are three community water supply[1] wells located approximately 4 to 5 miles north of the Site and a non-community water supply[2] well located approximately 2.5 miles south of the Site. There are three private wells located within approximately 200 feet west and east of the Site. There are additional private wells located within one mile south of the Site.

3.4 Land Use and Demographics

The land use in this rural area is predominantly agricultural with some residential and private recreational areas near the Site. The population in the vicinity of the site is sparse. Graphics were generated by ATSDR's Geospatial Research, Analysis, and Services Program (GRASP) to describe the local demographics. These data show the following potential sensitive populations within a 0.5-mile radius of the Site:

- Total population: 43
- Children <6 years of age: 2 (5% of population)
- Adults ≥ 65 years of age: 13 (30% of population)
- Females 15 to 44 years of age: 3 (7% of population)

There is a small portion of the population that is Spanish-speaking only or speak English as a second language in Galena. IDPH will produce Spanish versions of our outreach materials for the Site to widen the outreach audience. See **Appendix C** for GRASP maps.

3.5 Prior IDPH Involvement

Following the 2000 IA, IDPH notified the residents on the residential property of a water sample collected from their well, which indicated elevated levels of lead. The residents were advised to use an alternate source of water for drinking and cooking.

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[1] A community water supply is a public water system that supplies water to the same population year-round (EPA, 2022)

[2] A non-community water supply is a public water system that supplies water to at least 25 people for six months of the year, or a public water system that supplies water to transient populations like those at a gas station or campground (EPA, 2022).

In December of 2003, IDPH published a health consultation, which assessed exposures to potential COCs at the tailings pile and the concentration of lead in the well at the residential property in the West Area. This health consultation concluded that the lead in site soil and tailings posed no apparent public health hazard based on 2000 IA sampling data. The 2009 heavy rainfall event and subsequent washing of tailings onto the adjacent residential property prompted IDPH to reevaluate exposure conditions at the Site.

3.6 Site Visits

Representatives from IDPH visited the site on June 18, 2002, October 31, 2012, and October 13, 2022.

IDPH observed during the 2002 visit that:

- There was almost no vegetation growing on the mine tailings.
- Although the East Area was fenced, access to the Site was largely unrestricted.
- All-terrain vehicle tracks were observed suggesting that the East Area is used for recreational activities.
- Mine tailings were observed in road ditches, drainage tubes, and on the west side of Blackjack Road.

IDPH observed during the 2012 visit that:

- Significant re-contouring of the mine tailings pile in the East Area had been done and grass was planted to control stormwater erosion.
- Several new stormwater retention ponds had been constructed to control migration of mine tailings from the East Area.
- A small fence with "No Trespassing" signs had been installed on the tailings pile along Blackjack Road, deterring individuals from accessing the East Area. Access from other directions remained unrestricted.
- Grass had been planted over the settling pond area in the West Area to control erosion of the mine tailings.

IDPH observed during the 2022 visit that:

- The residential property immediately to the West of the tailings pile received a new well and water treatment system. The residents were now using their water for drinking and cooking. Two adults and no children lived at this property.
- While access was unimpeded all along the northern, eastern, and southern boundaries of the tailings pile in the East Area, much of the area was steeply graded and there were no visible well-worn foot paths, indicating infrequent access.
- The western boundary of the tailings pile in the East Area was well-vegetated and contoured in a manner that future tailing run-off from precipitation events would be unlikely, according to the EPA Remedial Project Manager.
- The former horseshoe settling pond and overland flow route were now well-vegetated due to remediation using clean topsoil and biosolids.

3.7 Community Concerns

The EPA conducted two community meetings to explain the investigation and cleanup of the Bautsch-Gray site. IDPH attended the second meeting held on October 30, 2012. During that meeting and in later interviews with residents, the community expressed concerns about neighboring water wells that had not been sampled, windblown dust, water contamination of the Smallpox Creek, and mine tailings that had been hauled off the site and used for fill and driveways. Local officials were interviewed in 2013 as part of the EPA Community Involvement Plan and were concerned that having a NPL site in their jurisdiction could negatively affect property values (EPA, 2014). Additional neighboring water wells have been sampled in the years following these interviews and been found to be acceptable for drinking. In addition, windblown dust from the tailings pile is currently being addressed by the application of a dust suppressant by EPA. This PHA addresses the community's concern about contamination of Smallpox Creek, but there is not enough information to evaluate the remaining concern about the potential health hazard posed by mine tailings used for driveways and road fill.

4. Evaluation of Exposure Pathways

IDPH determines whether people may have come in contact with contaminants by examining *exposure pathways*. An exposure pathway is the route a contaminant takes from its source (where it began) to its end point (where it ends), and how people can contact (or become exposed to) the contaminant. An exposure pathway has five elements:

1. A source of contamination.
2. Transport through an environmental medium like air, soil, water, or food.
3. A point of exposure where people could contact the contaminant.
4. A route of exposure for the contaminant to be taken in by individuals.
5. A potentially exposed population (ATSDR, 2022a).

4.1 Assessment Methodology

Exposure pathways can be completed, potential, or eliminated. *Completed exposure pathways* are those for which all five pathway elements are evident and indicate that exposure to site related contaminants has occurred in the past, is now occurring, or will occur in the future. *Potential exposure pathways* are those for which one or more of the elements are missing, but information is insufficient to eliminate or exclude the element. Potential exposure pathways suggest that exposure to site-related contaminants could have occurred in the past, could be occurring now, or could occur in the future. *Eliminated exposure pathways* are missing one or more elements that will never be present. Eliminated exposure pathways indicate that exposure to site-related contaminants has not or never will occur (ATSDR, 2022a). IDPH also included a *non-assessable* exposure pathway category for pathways which cannot be assessed due to data being unavailable. Referenced figures in this section can be found in **Appendix B**.

4.2 Completed Pathways

4.2.1 Soil ingestion & dermal contact at the tailings pile for workers, hunters, and trespassers (past, present, and future)

Much of this East Area exposure unit is readily accessible except for a small fence along the east side of Blackjack Road. There is little vegetative cover to reduce contact with soil contaminants **(Figure 3)**. It is likely that workers, hunters, and trespassers who accessed this area were exposed to contaminated soil. Children under the age of 11 are not likely to access this area. Exposure conditions are largely unchanged from those of the past; therefore, present and future exposures are also likely. If the tailings pile is remediated in a manner which removes ready contact with tailings, then the future pathway will be eliminated.

4.2.2 Inhalation of dust on the tailings pile for workers, hunters, and trespassers (past)

During the 2014 removal activity, air monitoring was performed on the site. However, these data were collected over 4 days, under conditions non-conducive to dust migration (after rainfall), and only included particulate matter (PM) concentrations. PM measurements remained below the World Health Organization's 24-hour guidance of 15 micrograms per cubic meter for PM2.5 throughout the monitoring period (Tetra Tech, 2014). Metals sampling was not performed so the actual concentration of potential COCs in wind-blown dusts is unknown. EPA applied a soil stabilizer in 2021 which eliminates the current exposure pathway for inhalation of wind-blown dust on the tailings pile. The stabilizer is anticipated to prevent wind-blown dust for "several years" (Soilworks, n.d.). Workers, hunters, and trespassers are likely to have breathed in dust contaminated with potential COCs during dry and windy conditions prior to remediation. However, air sampling data for potential COCs are not currently available, so these exposures cannot be assessed. If air samples are collected in the future, and analyzed for potential COCs, IDPH will evaluate the data and provide an updated health assessment or consultation.

4.2.3 Soil ingestion & dermal contact in the surrounding wooded properties for property owners, workers, hunters, and trespassers (past, present, and future)

This exposure unit is readily accessible and there is evidence of use by hunters. There is more vegetative cover in this area which could possibly reduce the magnitude of exposures. Children under the age of 11 are not likely to access this area. Exposure conditions are largely unchanged from those of the past; therefore, present and future exposures are also likely. If the tailings are removed from the surrounding wooded properties, then the future pathway could be eliminated.

4.2.4 Soil and indoor dust ingestion & dermal contact with soil at the residential property for property owners (past, present, future)

Satellite imagery of the Site from 1970 shows evidence of mine tailings washed onto the residential property (IEPA, 2002) and IDPH assumes they were never removed. Therefore, exposures could have occurred as early as 1970. Additionally, as previously mentioned, heavy precipitation events caused tailings to erode onto the residential property in 2009 and 2011. These tailings remained on the property until removal activities were conducted from approximately fall of 2010 through the beginning of 2012. Residents could have been exposed to potential COCs while the tailings were on the property. EPA removed 2,600 cubic yards of contaminated soil and mine tailings from the area in 2010 and removed more tailings after a repeat heavy precipitation event in 2011 (SulTRAC, 2016). There is little risk of future erosion events of tailings washing out onto the residential property due to contouring and grading performed on the tailings pile along with added berms to prevent runoff (EPA Remedial Project Manager, personal communication, 2022).

Arsenic, lead, and manganese were detected in soil samples collected during the 2014 RI. Arsenic exceeded its screening value and was included for further evaluation. Manganese was also selected for further evaluation because a screening value is not available. Lead was considered adequately addressed at the time of the investigation because soil lead concentrations did not exceed the 400 mg/kg screening level used at that time. In 2024, the screening level for evaluating residential sites with soil lead contamination was lowered to 200 mg/kg (EPA, 2025a). Therefore, the updated screening level was applied to evaluate past, present, and future lead exposures at the residential property and lead was found above this screening level.

4.2.5 Soil ingestion & dermal contact in horseshoe settling pond and overland flow route for workers and hunters (past)

These locations in the West Area were poorly vegetated for many years and were used extensively by hunters during hunting activities, resulting in past exposures. Children under the age of 11 are not likely to have accessed this area. This area has been covered with topsoil and is currently well vegetated, making current and future exposures less likely, but not eliminated. A concern could exist if residential properties are built in these areas in the future.

4.2.6 Consumption of fish from Smallpox Creek for fishers (past)

According to one report of an individual using the creek for fishing (SulTRAC, 2016), there is a completed pathway for fish consumption at Smallpox Creek. People who ate fish from Smallpox Creek could have been exposed to heavy metals in fish tissue.

4.3 Potential Pathways

4.3.1 Inhalation of dust from the tailings pile for workers, hunters, trespassers, and residents (future)

The soil stabilizer currently preventing windblown dust from the tailings pile may become less effective in the future, thus enabling the dusts to be transported through the air and able to be inhaled. Persons at risk of exposure would be on-site workers, hunters, trespassers, and residents of the residential property.

4.3.2 Soil ingestion and dermal contact in horseshoe settling pond and overland flow route for all groups (present & future)

These locations were covered with topsoil, fertilized with biosolids, and are currently covered in thick vegetation. This makes exposure to contaminants in tailings below the topsoil less likely. However, it does not eliminate the possibility of future exposure because the tailings are still in place, particularly if residential properties are built in these areas.

4.3.3 Ingestion of drinking water at the residential property for residents (past)

The current residents did not use their former well for drinking or cooking since moving into the home in 1993, so no exposure has occurred for these individuals. Given that the original well was likely drilled into a lead ore bearing formation (SulTRAC, 2016) and historical well sampling data show consistent concentrations of approximately 26 µg/L of lead in untreated water in samples spanning more than 10 years (IEPA, 2001; Weston Solutions, Inc, 2009), it is reasonable to expect similar exposure conditions prior to 1993. Therefore, residents who lived at the residential property prior to 1993 are expected to have been exposed to lead in their drinking water; particularly those who had the well drilled. However, IDPH does not have information to confirm this, with no water sampling prior to 1993.

4.3.4 Ingestion & dermal contact with sediment in Smallpox Creek for anglers (past, present & future)

Anglers could incidentally ingest contaminated sediment along Smallpox Creek. Sediment samples collected during the 2014 RI showed high concentrations of potential COCs in one specific area of the creek. It is a small, low-flow creek which has not been reported to be used for swimming, canoeing, or play. Therefore, exposure during these activities is unlikely.

4.3.4 Ingestion of surface water in Smallpox Creek for recreationalists (past, present & future)

Anglers wade-fishing in the Smallpox Creek could incidentally ingest surface water. Elevated concentrations of arsenic in surface water were found during the 2014 RI (SulTRAC, 2016). There have not been reports of people using the creek for swimming, canoeing, or play. Therefore, exposure during these activities seems unlikely.

4.3.5 Consumption of fish from Smallpox Creek for anglers (present & future)

People who eat fish from Smallpox Creek could be exposed to heavy metals in fish tissue. However, there have been no recent reports of fishing or fish consumption in Smallpox Creek, and past sampling efforts did not produce sufficient data despite the use of backpack electroshocking. Based on this information, the creek is too small to support recreational fishing on a consistent basis.

4.4 Eliminated Pathways

4.4.1 Ingestion of surface water on the tailings pile for all groups (past, present & future)

People are unlikely to be exposed to contaminants in the retention ponds and/or other ponds that form on the tailings pile during heavy rains.

4.4.2 Ingestion of drinking water at residential property for property owners (present & future)

A new well was drilled at the residential property in the summer of 2022. Additionally, a new reverse osmosis treatment system was installed. The new well was drilled to a depth of 298 feet. This is below the known lead ore deposits in the area, which are present from approximately 25-175 ft bgs (SulTRAC, 2016). Confirmation sampling of the new well shows lead concentrations of less than 15 µg/L pre-treatment and non-detected post-treatment.

4.4.3 Inhalation of dust on the tailings pile for all groups (present)

A soil stabilizer was applied to the tailings pile in 2021. This stabilizer suppresses wind-blown dust from the tailings pile and eliminates current exposures.

4.5 Non-Assessable Pathways

4.5.1 Ingestion and dermal contact with mine tailings used in residential driveways for property owners (past, present, future)

There were community concerns regarding possible exposures to tailings which had been hauled from the Site and used as fill for driveways at various residences in nearby communities. This pathway is impossible to assess without information on when and where the tailings were used or sampling data from the tailings used for fill.

The table below provides a visualization of each exposure pathway:

Table 1: Bautsch - Gray Mine Site Exposure Pathways: Past, Present, and Future

Exposure Unit	Exposure Type	Exposure Groups	Past	Present	Future
Tailings Pile	Soil Ingestion and Dermal Contact	Workers, Hunters, and Trespassers	C	C	C
Tailings Pile	Dust Inhalation	Workers, Hunters, Trespassers, Property Owners, and Residents of the Residential Property	C	E	P
Tailings Pile	Incidental Water Ingestion	Hunters and Trespassers	E	E	E
Surrounding Wooded Properties	Soil Ingestion and Dermal Contact	Property Owners, Workers, Hunters, and Trespassers	C	C	C
Residential Property	Soil Ingestion and Dermal Contact	Adult and Child Residents	C	C	C
Residential Property	Drinking Water Ingestion	Adult and Child Residents	P	E	E
Horseshoe Settling Pond and Overland Flow Route	Soil Ingestion and Dermal Contact	Workers, Hunters, and Trespassers	C	P	P
Smallpox Creek	Fish Consumption	Anglers	C	P	P
Smallpox Creek	Sediment Ingestion and Dermal Contact	Anglers and Recreationalists	P	P	P
Smallpox Creek	Surface Water Ingestion	Anglers and Recreationalists	P	P	P

Exposure Unit	Exposure Type	Exposure Groups	Past	Present	Future
Galena Driveways	Soil Ingestion and Dermal Contact	Galena Residents	UNK	UNK	UNK

C = Completed; P = Potential; E = Eliminated; UNK = Unknown, not assessable

5. Environmental Contamination

The overall goal of this health assessment is to determine if exposure to site related contaminants poses a public health hazard and, if so, to make recommendations to protect public health. This is a two-step process involving:

- a screening analysis of the environmental data to identify potential COCs
- estimating exposure doses to those people who contact potential COCs, comparing the exposure doses to health-based guidelines established by ATSDR and EPA, conducting an in-depth toxicological evaluation, and assessing the likelihood of harmful health effects from the site-related exposures.

IDPH uses health-based comparison values (CVs) to identify potential COCs in air, water, and soil. First, the maximum concentrations of detected contaminants are compared to media-specific CVs. If contaminant concentrations exceed their CV, it is referred to as a potential contaminant of concern and selected for further evaluation. If health-based CVs or alternative screening values are unavailable, the contaminants are selected for further evaluation. Contaminant levels less than a CV are unlikely to pose a health threat and are not considered any further in this assessment. Contaminant levels greater than the CV do not necessarily indicate that harmful health effects are likely, but rather that the contaminants need further evaluation. Once exposure doses and cancer risks are estimated, they are compared with health guideline doses and allowable cancer risks to determine the likelihood of health effects. All referenced figures in this section are provided in **Appendix B**.

5.1 Environmental Guideline Comparison

There are several health-based CVs available for screening environmental contaminants to identify potential COCs. These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncarcinogenic health effects (ATSDR, 2022a). RMEGs represent the concentration in a specific medium (e.g., water, soil) at which daily human exposure for a chronic duration is unlikely to result in noncarcinogenic effects (ATSDR, 2022a). If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation

Guides (CREGs) are also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional cancer in 1 million (1.0E-06) persons exposed over their lifetime (78 years) (ATSDR, 2022a).

In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media. These include EPA Maximum Contaminant Levels (MCLs) used for drinking water and EPA Regional Screening Levels (RSLs) used for drinking water and soil (ATSDR, 2022a). IDPH used the EPA RSL of 200 mg/kg to screen lead concentrations in soil based on minimal evidence of additional lead sources which could contribute to lead exposures and the background soil lead concentration being 155 mg/kg in Jo Daviess County. The Glossary of Terms in **Appendix E** provides further detail on these CVs.

5.2 East Area

The environmental data presented in this section is grouped according to the exposure units within the East Area: the tailings pile and the surrounding wooded properties. The data evaluated for the East Area include mine tailings and soil samples. Limited air sampling was conducted during two separate remediation projects and results were well-below the current World Health Organization 24-hour Air Quality Guideline for PM2.5 (15 micrograms per cubic meter (µg/m3)), with the exception of transient spikes which had sources unrelated to the Site (Tetra Tech, 2014). Surface water sampling data are available but relate to temporary retention ponds on the tailings pile that result from heavy rains. They are not expected to be used for drinking water or recreation due to their size, depth, and transient nature. Therefore, incidental ingestion of surface water at the tailings pile is not a completed exposure pathway, so the data were not evaluated.

Contaminants detected in the East Area above applicable soil CVs include arsenic, cadmium, lead, manganese, and zinc.

A large portion of the available surface soil sampling data for arsenic, lead, and zinc are from “adjusted” X-ray fluorescence (XRF) data collected from 0 to 6 inches bgs during the 2009 SA and the 2014 RI. These data were compared to laboratory data and adjusted using linear regression models to make the two data sets statistically correlated and comparable. All manganese samples were analyzed in a laboratory. Laboratory data and adjusted XRF data were then used to characterize the levels of metals in mine tailings and soils.

Numerous XRF samples were collected throughout the surrounding wooded properties during the 2014 RI, but the XRF cadmium results were not adjusted to analytical data. For this reason, these XRF data on cadmium were not used in this assessment. Maximum analytical results from the 2009 SA were used to evaluate cadmium, of which few were available throughout much of the Site.

5.2.1 Tailings Pile – Soil and Tailings

A total of 20 samples were collected from 0 to 6 inches bgs during the 2000 IA and 2009 SA.

One sample was taken from the southeastern edge of the tailings pile during the 2000 IA **(Figure 4)**. Samples were also collected along the perimeter of the tailings pile during the 2009 SA **(Figure 5).** The highest observed concentrations were near the southeastern edge of the tailings pile. **Table 2** summarizes the results of the 2000 IA and 2009 SA samples in comparison to applicable CVs. Manganese was not analyzed in this investigation.

Table 2: Tailings Pile Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2000 Integrated Assessment and 2009 Site Assessment

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	20	28	760	16 (EMEG*)	Yes
Cadmium	1	95	95	5.2 (EMEG)	Yes
Lead	20	615	15,700	200 (EPA RSL†)	Yes
Zinc	20	2,403	219,165	16,000 (EMEG)	Yes

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

5.2.2 Surrounding Wooded Properties – Soil

Twenty-one adjusted XRF samples and six analytical samples were collected during the 2009 SA **(Figures 5 and 6)**. Dozens of samples were collected from a grid in the wooded areas around the north, east, and south sides of the tailings pile during the 2014 RI **(Figure 7)**. All samples were collected from 0 to 6 inches bgs. **Table 3** summarizes the results of the 2009 SA and 2014 RI samples in comparison to applicable CVs.

Table 3: Surrounding Wooded Properties Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2009 Site Assessment and 2014 Remedial Investigation

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	147	4	186	16 (EMEG*)	Yes
Cadmium	6	0.64	120	5.2 (EMEG)	Yes
Lead	155	19	13,500	200 (EPA RSL†)	Yes
Manganese	25	696	1,990	N/A	N/A
Zinc	155	72	80,500	16,000 (EMEG)	Yes

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

5.3 West Area

The environmental data presented in this section is grouped according to three exposure units within this Area: the residential property, horseshoe settling pond and overland flow route, and

Smallpox Creek. The data evaluated for the West Area include soil and sediment, surface water, and fish tissue samples collected from Smallpox Creek. Smallpox Creek is a shallow, slow-flowing creek, which is not known to be used currently for regular recreational use. There have not been recent reports of people using the creek for swimming, canoeing, or playing. However, based on past reports of the creek being used for fishing, and community concerns regarding contamination in Smallpox Creek, soil and sediment and surface water sampling data were evaluated for anglers who wade in the creek to catch fish.

The potential COCs in the West Area are arsenic, cadmium, lead, manganese, and zinc. Laboratory data and adjusted XRF data from the 2009 SA and 2014 RI were used to evaluate soil contaminants. Unadjusted cadmium results from 2014 RI sampling were not used in this evaluation. Maximum analytical results from the 2009 SA were used to evaluate cadmium. All manganese samples were analyzed by a laboratory.

5.3.1 Residential Property – Soils

One sample was collected for laboratory analysis near the driveway of the residential property at 0 to 6 inches bgs during the 2000 IA (IEPA, 2001) **(Figure 4)**. Eighteen soil samples were collected for laboratory analysis during the 2009 SA (Weston Solutions, Inc, 2010) **(Figures 5 and 6)**. The samples were collected from 0 to 6 inches bgs. Additional sampling was conducted at the eastern edge of the property during the 2014 RI **(Figure 7)**. **Tables 4, 5, and 6** summarize the results of samples from all three investigations in comparison to applicable CVs. Manganese was not analyzed in the 2009 SA.

Table 4: Residential Property Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2000 Integrated Assessment

Contaminant	Number of Samples	Concentration	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	1	32	16 (EMEG*)	Yes
Cadmium	1	5.3	5.2 (EMEG)	Yes
Lead	1	512	200 (EPA RSL†)	Yes
Manganese	1	ND‡	N/A	N/A
Zinc	1	1,950	16,000 (EMEG)	No

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level
‡ ND = Not detected

Table 5: Residential Property Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2009 Site Assessment

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	18	4	66	16 (EMEG*)	Yes
Cadmium	18	0.56	200	5.2 (EMEG)	Yes
Lead	18	23	1,300	200 (EPA RSL†)	Yes
Zinc	18	81	72,000	16,000 (EMEG)	Yes

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

Table 6: Residential Property Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2014 Remedial Investigation

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	3	7	16	16 (EMEG*)	Yes
Cadmium	3	1	3	5.2 (EMEG)	No
Lead	3	78	390	200 (EPA RSL†)	Yes
Manganese	3	846	3,370	N/A	N/A
Zinc	3	435	1,010	16,000 (EMEG)	No

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

5.3.2 Horseshoe Settling Pond and Overland Flow Route – Soils

A total of 96 surface samples were collected from this exposure unit during the 2000 IA, 2009 SA, and 2014 RI **(Figures 4, 5, 6, and 7)**. All samples were collected from 0 to 6 inches bgs. Lead and zinc were the only contaminants analyzed in each sampling event conducted, leading to a larger number of samples for these two contaminants. **Table 7** summarizes the results of these samples in comparison to applicable CVs.

Table 7: Horseshoe Settling Pond and Overland Flow Route Soil Sampling Results in Milligrams per Kilogram (mg/kg): 2000 Integrated Assessment, 2009 Site Assessment, & 2014 Remedial Investigation

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	68	7	97	16 (EMEG*)	Yes
Cadmium	4	11	29	5.2 (EMEG)	Yes

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Lead	96	48	4,984	200 (EPA RSL†)	Yes
Manganese	15	577	2,685	N/A	N/A
Zinc	96	120	14,090	16,000 (EMEG)	No

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

5.3.3 Smallpox Creek – Sediment

There has been extensive sediment sampling to determine the possible impact of the Site on Smallpox Creek throughout multiple investigations. A total of 44 sediment samples were collected during the 2000 IA and 2014 RI along various points in the creek. All samples were collected from 0 to 6 inches bgs. **Table 8** summarizes the results of the 2000 IA and 2014 RI samples in comparison to applicable CVs. Manganese was not analyzed in either investigation.

Table 8: Smallpox Creek Sediment Sampling Results in Milligrams per Kilogram (mg/kg): 2000 Integrated Assessment and 2014 Remedial Investigation

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	44	7	31.2	16 (EMEG*)	Yes
Cadmium	44	ND	213	5.2 (EMEG)	Yes
Lead	44	54	4,360	200 (EPA RSL†)	Yes
Zinc	44	144	92,500	16,000 (EMEG)	Yes

* ATSDR's Environmental Media Evaluation Guide
† EPA's Regional Screening Level

Apart from arsenic, all maximum detections were found in one sediment sample well upstream of the tailings pile. Concentrations of potential COCs decrease drastically in downstream samples. Given local topography and unremarkable detections of potential COCs in upstream soils, it appears unlikely these detections were due to tailings eroding to this location in the stream from heavy rains. Therefore, IDPH assumes that dumping of mine tailings or other material occurred in this location.

5.3.4 Smallpox Creek – Surface Water

Six surface water samples were collected from Smallpox Creek during the 2014 RI. The samples were collected from random locations upstream and downstream from the Site **(Figure 8)**. **Table 9** further summarizes the arsenic and cadmium results of the 2014 RI samples in comparison to applicable CVs. No other metals were analyzed for this sampling event.

Table 9: Smallpox Creek Surface Water Sampling Results in Micrograms per Liter (µg/L): 2014 Remedial Investigation

Contaminant	Number of Samples	Concentration Minimum	Concentration Maximum	Comparison Value (CV)	Maximum Exceeds CV?
Arsenic	6	0.88	1.8	0.00076 (CREG*)	Yes
Cadmium	6	0.19	0.39	0.71 (EMEG†)	No

* ATSDR's Cancer Risk Evaluation Guide
† ATSDR's Environmental Media Evaluation Guide

The concentrations of arsenic and cadmium in surface water were much lower than the concentrations in sediment. EPA and their contractor for the remedial investigation concluded that the concentrations in surface water were likely to be naturally occurring. (SulTRAC, 2016).

5.3.5 Smallpox Creek – Fish Tissue

Fish tissue samples were collected from Smallpox Creek upstream and downstream of the overland flow route **(Figure 8)** and analyzed for metals during the 2014 RI. Seven samples consisted of whole-body composite samples of small bass, chubs, and shiners. Two individual fillet samples were collected from a white sucker and a small northern pike. However, these data were not evaluated because the creek is too small to provide enough fish for year-round exposure.

5.4 Summary of Potential Contaminants of Concern

The final potential COCs selected for further analysis in this assessment are shown in **Table 10**. A brief discussion of toxicological characteristics for each potential COC is in **Appendix F**.

Table 10: Summary of Potential Contaminants of Concern

Media	Exposure Unit	Potential Contaminants of Concern
Soil and mine tailings	Tailings Pile	Arsenic, Cadmium, Lead, Zinc
Soil and mine tailings	Surrounding Wooded Properties	Arsenic, Cadmium, Lead, Manganese, Zinc
Soil and mine tailings	Residential Property	Arsenic, Cadmium, Lead, Manganese, Zinc
Soil and mine tailings	Horseshoe Settling Pond and Overland Flow Route	Arsenic, Cadmium, Lead, Manganese
Sediment	Smallpox Creek	Arsenic, Cadmium, Lead, Zinc
Surface Water	Smallpox Creek	Arsenic

6. Public Health Implications of Completed Pathways

Once it has been determined that individuals have or are likely to have contact with site-related contaminants, the next step in the public health assessment process is the calculation of site-specific exposure doses if a contaminant is detected above screening levels. This involves looking more closely at site-specific exposure conditions, the estimation of exposure point concentrations and doses, and comparison to health guidelines. Health guidelines are based on data drawn from the epidemiological and toxicological literature and often include uncertainty factors to ensure that they are protective of human health. The purpose of this evaluation is to determine if residents were exposed to potential COCs at levels that might cause harmful effects and to describe those harmful effects.

6.1 Exposure Point Concentrations

ATSDR's Public Health Assessment Guidance Manual suggests that an exposure point concentration (EPC) be used to evaluate human health risk for each potential contaminant of concern. An exposure point concentration is a representative concentration over an area to which a person may be exposed. Several different methods can be used to determine the EPC. When sufficient environmental data are available, the 95 percent upper confidence limit (95UCL) of the average concentration is calculated for each contaminant in an exposure unit. When data are insufficient and a 95UCL of the mean cannot be calculated, we use the maximum detected concentration in an exposure unit to estimate exposure (ATSDR, 2023).

Exposure point concentrations were estimated using ATSDR's EPC Tool and exposure dose guidance for discrete and non-discrete samples. For the purposes of this report, IDPH used the 95UCL for exposure units with 8 or more samples. For exposure units or individual contaminants with fewer than 8 sample results, the maximum concentration was used as the EPC. For lead samples, we followed EPA's recommendation and used the arithmetic mean in the All-Ages Lead Model (AALM). See **Tables 11 - 18** in **Appendix D** for EPCs used to further evaluate exposure to contaminants in soil, tailings, sediment, and surface water.[3]

6.2 Health Guideline Comparison

To assess noncancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, noncancer health effects. MRLs are developed for three routes of exposure (ingestion, inhalation, or dermal contact), and time periods (less than 14 days (acute), 14 to 364 days (intermediate), and 365 days (chronic). MRLs are based on animal studies or reports from human studies. They are derived from no effect levels or from levels at

[3] To assess arsenic exposures in soil, IDPH used EPA guidance of assuming 60% relative bioavailability of arsenic in soil (EPA, 2012b). Bioavailability refers to the amount of a substance that is absorbed by the body after ingestion in a specific medium, like soil.

which adverse effects have been observed and adjusted using a series of uncertainty factors or using statistical models. Observable effect levels include no-observable-adverse-effect levels (NOAELs) and lowest-observable-adverse-effect levels (LOAELs).

The risk for noncancer adverse health effects is assessed by calculating and comparing an exposure dose to the MRL or to EPA's Reference Dose (RfD) via a ratio known as the "hazard quotient" (HQ). The HQ is defined as: Hazard Quotient = Exposure Dose/MRL or Exposure Dose/RfD. When a HQ is above 1, further toxicological evaluation is needed to determine whether harmful effects might be expected. Potential COCs with a hazard quotient exceeding a value of 1 were further evaluated to determine whether these contaminants pose a health threat to potentially exposed populations (ATSDR, 2022a). All potential COCs with a HQ less than 1 were not further evaluated for noncancer health effects.

ATSDR has not developed an MRL for human exposure to lead, nor has EPA developed a RfD. Therefore, the usual approach of estimating human exposure to an environmental contaminant and then comparing this dose to a health guideline, such as an MRL or RfD, cannot be used. Instead, exposure to lead can be evaluated by using a biological model that predicts BLL that would result from exposure to environmental lead contamination.
ATSDR has not developed an MRL for manganese. EPA has developed a dietary reference dose (RfD) of 0.14 milligrams per kilogram per day (mg/kg/day) (EPA, 1995), but this dosage exceeds the LOAEL in several human studies and should not be used to assess drinking water and soil exposures (ATSDR, 2022c). Therefore, to assess the potential for noncancer effects from manganese exposure at the Site, IDPH compared estimated manganese doses to the lowest LOAEL of 0.06 mg/kg/day (ATSDR, 2012a).

For carcinogens, exposure doses are multiplied by EPA cancer slope factors (CSF) to assess the theoretical risk of a contaminant to cause cancer (ATSDR, 2022a). The excess risk of cancer from exposure to a contaminant is described in terms of the probability that an exposed individual will develop cancer because of that exposure by age 78. In general, IDPH considers excess cancer risks (CRs) below one chance in one million (1×10^{-6} or 1E-6) to be so small as to be negligible. Risks above one in ten thousand (1×10^{-4} or 1E-4) are sufficiently large that a significant risk for increased cancer cases exists (ATSDR, 2022c).

A discussion of the MRLs, cancer slope factors, and other terms are found in the Glossary of Terms in **Appendix E**.

7. Noncancer Health Effects

7.1 Exposure Dose Assumptions and Scenarios

Surface soil and mine tailings, sediment, and surface water are the environmental media under consideration in this assessment. Exposure to contaminants in these media may occur through:

- ingestion of surface soil, mine tailings, household dust, and sediment

- dermal contact with surface soil, mine tailings, and sediment
- ingestion of surface water

Exposure doses are calculated using the ATSDR. For 50th percentile, or average intake rate, a *central tendency exposure* (CTE) scenario was used. For 95th percentile, or above average intake rate, a *reasonable maximum exposure* (RME) was used. The RME refers to intake rates which are above average but are still realistic. Based on local information and site visits, IDPH has developed exposure scenarios for ten past, present, or future exposure pathways (**Table 1**). Referenced tables in this section are available in **Appendix D**.

No safe level of lead in the blood has been identified. However, the Centers for Disease Control and Prevention (CDC) has established a blood lead reference value (BLRV). The reference value is not meant as a predictor of harmful effects, but rather as a protective guideline to help determine when medical or environmental follow-up should be initiated and to guide efforts in reducing lead exposures in communities (CDC, 2024). In 2021, CDC updated the BLRV from 5 µg/dL to 3.5 µg/dL, based on a recommendation by the Lead Exposure Prevention Advisory Committee (LEPAC). LEPAC's recommendation used data from the 2015-2016 and 2017-2018 National Health and Nutrition Examination Survey (NHANES) cycles (CDC, 2024).

IDPH used two types of modeling software to assess exposures to lead in soil and household dust: EPA's Integrated Exposure Uptake Biokinetic (IEUBK) and EPA's AALM. The IEUBK reports projected BLLs based on a concentration of lead in soil and indoor dust for children aged 1 to less than 6 years old. Therefore, exposure scenario results from the IEUBK will only be reported for children 1 to less than 6 years old. The AALM reports the percentage of probability that a person's BLL will exceed a specified target BLL based on the concentration of lead in various media, duration of exposure, and sex of those exposed.

Baseline BLLs were derived when using the AALM based on sex, age, and the lowest geometric mean BLL from NHANES blood lead data relative to the estimated time of exposure. Baseline BLLs are used to account for exposures to lead elsewhere in someone's environment up until exposure starts, thus providing a more realistic modeling result of the impact of the exposure on BLLs. IDPH used target BLLs of 3.5 and 5 micrograms per deciliter (µg/dL) for this report. Projections which exceeded a 5% chance of exceeding the target BLL of 5 µg/dL were considered a health hazard, based on current ATSDR guidance, and are the only results presented in main text. All modeling results are located in **Appendix D**.

Additionally, an exposure period of 39 weeks instead of 52 weeks was used for some scenarios to account for the times of year when the ground will be frozen, or winter precipitation is covering tailings or soil with snow or ice.

7.1.1 Soil Ingestion and Dermal Contact at Tailings Pile

7.1.1.1 Assumptions

Exposure scenarios were run for multiple exposed populations (*workers, hunters, and trespassers*) according to site-specific parameters. The population is sparse in this rural area and the Site is not regularly accessed. IDPH does not believe the tailings pile is accessed by children under 11 years of age. Because the tailings pile is not reported to be regularly accessed by nearby property owners, exposure assumptions were only formed for workers, hunters, and trespassers. IDPH ran exposures which reflect these conditions. The following assumptions were made regarding the frequency that different groups accessed the property:

Workers: Five days a week, 12 weeks a year, for one year – This is based on remediation work being conducted on the tailings pile by various contractors over multiple years. Each remedial project lasts days to weeks rather than months to years. Considering the intermittent nature of remedial projects, a duration of one year of exposure was used to account for individuals who may have worked on multiple projects intermittently throughout one year.

Hunters/Trespassers: Two days a week, 39 weeks a year, for 10 years (children) and 33 years (adults) – IDPH only ran scenarios for children aged 11-21 and adults aged 21-54. The same assumption was also conservatively applied to the trespasser population.

7.1.1.2 Scenario Results

Workers: Based on the EPCs for arsenic, cadmium, and zinc **(Table 11)**, the combined (ingestion and dermal) HQs for CTE and RME exposures for adult workers were calculated using PHAST. HQs for chronic, intermediate, and acute exposures were less than 1. Based on these results, IDPH does not believe worker exposures to arsenic, cadmium, and zinc at the tailings pile will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures for male and female workers based on the EPC for lead (2,445 mg/kg), CTE intake rate for low-intensity contact (100 mg/day), and a target BLL of 5 µg/dL. For male and female workers, there was less than a 5% chance of exceeding the target BLL of 5 µg/dL. **Table 19** summarizes modeling results for this exposure scenario.

Hunters/Trespassers: Based on the EPCs for arsenic, cadmium, and zinc **(Table 11)**, the combined (ingestion and dermal) HQs for CTE and RME scenarios for children aged 11-21 years old and adults were calculated using PHAST. HQs were less than 1 for chronic, intermediate, and acute exposures. Based on these results, IDPH does not believe hunter/trespasser exposures to arsenic, cadmium, and zinc in this exposure unit will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures for male and female hunters/trespassers based on the EPC for lead (2,445 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. IDPH estimated exposures for children based on exposures from ages 11-21 and adult exposures from ages 21-54. Adult male and female hunters/trespassers were projected to have a 9% and 5% probability of exceeding the target BLL of 5 µg/dL, respectively. **Table 19** summarizes all modeling results for this exposure scenario.

7.1.2 Soil Ingestion & Dermal Contact in Surrounding Wooded Properties

7.1.2.1 Assumptions

Due to the greater amount of vegetative ground cover in this exposure unit, only CTE exposures were considered, as RME exposures are not likely. Similarly, CTE soil ingestion rates were used to calculate projected BLL concentrations. A unique exposure assumption was made for the property owners group because they are expected to use the exposure unit for recreation as well as hunting:

Property owners: Two days a week, 39 weeks a year, for 10 years (children) and 33 years (adults) – This is a conservative estimate of nearly daily access by property owners when contact with site soil is expected. IDPH ran scenarios for children aged 11-21 and adults aged 21-54.

Other than these exceptions, the same assumptions made for the previous exposure unit were used.

7.1.2.2 Scenario Results

Property owners: Based on the EPCs for arsenic and zinc (Table 12), the combined (ingestion and dermal) HQs for CTE exposures for children (aged 11 -21 years old) and adults were calculated using PHAST. HQs were less than 1 for chronic, intermediate, and acute exposures.

No health guideline exists for manganese; therefore, we compared estimated exposure doses in children (11 and older) and adults to known effect levels from human studies. The maximum dose for children aged 11-16 (0.0018 mg/kg/day) is 33 times less than the LOAEL for manganese (0.06 mg/kg/day). Based on this comparison, IDPH does not believe property owner exposures to arsenic, zinc, and manganese in the wooded areas will cause adverse noncancer health effects.

Chronic CTE HQs for cadmium exceeded 1 (1.2) for the children aged 11-16 years group. The children aged 16-21 years and adult groups had HQs less than 1. The CTE dose (0.00012 mg/kg/day) is just above the chronic oral MRL (0.0001 mg/kg/day) but still below estimates of chronic cadmium intake that would result in an excess risk of renal effects after decades of constant exposure for the children aged 11-16 years group. Therefore, IDPH does not believe that cadmium exposure for children 11-16 years old in the surrounding wooded properties will cause adverse noncancer health effects. Table 20 summarizes the HQs for this exposure scenario.

The AALM was used to evaluate lead exposures for male and female property owners based on the EPC for lead (751 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. IDPH estimated exposures for children based on exposures from ages 11-21 years and adult exposures from ages 21-54 years. Adult male property owners were projected to have an 8% probability of exceeding the target BLL of 5 µg/dL. Female property owners and children of property owners who visited the wooded properties had a less than 5% chance of exceeding 5 µg/dL. Table 21 summarizes all modeling results for this exposure scenario.

Workers: Based on the EPCs for arsenic, cadmium, and zinc (Table 12), the combined (ingestion and dermal) HQs for CTE exposures for outdoor workers with low-intensity soil contact were calculated using PHAST. HQs for chronic, intermediate, and acute exposures were less than 1.

No health guideline exists for manganese; therefore, we compared estimated site doses for workers to known effect levels from human studies. The maximum dose of manganese (0.00047 mg/kg/day) in workers was 127 times lower than the LOAEL of 0.06 mg/kg/day. Based on these results, IDPH does not believe worker exposures to arsenic, cadmium, manganese, and zinc in the wooded areas will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures to male and female workers based on the EPC for lead (751 mg/kg), a CTE intake rate for low intensity soil contact (100 mg/day), and a target BLL of 5 µg/dL. There was less than a 5% chance of exceeding the target BLL for male and female workers. Table 21 summarizes all modeling results for this exposure scenario.

Hunters/Trespassers: Based on the EPCs for arsenic, cadmium, and zinc (Table 12), the combined (ingestion and dermal) HQs for CTE and RME scenarios for children aged 11-21 years old and adults were calculated using PHAST. HQs were less than 1 for chronic, intermediate, and acute exposures. Based on these results, IDPH does not believe hunter/trespasser exposures to arsenic, cadmium, and zinc in this exposure unit will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures to hunters and trespassers based on the EPC for lead (751 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. IDPH estimated exposures for children based on exposures from ages 11-21 years and adult exposures from ages 21-54 years. There was less than a 5% chance of exceeding the target BLL for male and female hunters and trespassers for both children (11-21 years) and for adults. Table 21 summarizes all modeling results for this exposure scenario.

7.1.3 Soil Ingestion & Dermal Contact at the Residential Property

7.1.3.1 Assumptions

The residential property has gone through multiple environmental conditions since the home was constructed in 1938 (personal communication with Jo Daviess County assessment clerk, 2024). Satellite imagery from 1970 show tailings washed onto the property (IEPA, 2002), and sampling data from the 2000 IA shows soil arsenic and lead above applicable comparison values (IEPA, 2001). These data were used to evaluate lead exposures for those living at the property from 1970 until 1993, when the current residents moved to the property. This is because lead does not degrade over time in soil (ATSDR, 2020); therefore, any contamination left by the tailings in the 1970 erosion event would still be present when sampling occurred in 2000. Exposures were assessed for the current residents from 1993 until 2009 based on the same reasoning. However, detections of arsenic, cadmium, and zinc were not used to evaluate exposures, because their soil concentrations can change over time due to a variety of soil characteristics (ATSDR, 2005; ATSDR, 2007; ATSDR, 2012b). In addition to the persistent erosion from as early as 1970, a heavy rain event caused a large amount of tailings to erode onto the property from the tailings pile in 2009 and 2011. All mine tailings were removed from the property in 2011 and based on available information, no other tailings erosion events have occurred.

IDPH developed the following exposure assumptions and scenarios for each of the environmental conditions at the residential property:

Past Child and Adult Resident (Past Exposure, 1970-1993): 7 days a week, 52 weeks a year, for 23 years – This is a conservative assumption of daily yard activity and indoor dust ingestion by occupants who lived at the home prior to the current residents based on when tailings were known to have impacted the property until the year the current residents moved in.

Current Adult Resident (Past Exposure, 1993-2009 Pre-Erosion Incident): 7 days a week, 52 weeks a year, for 16 years – This is a conservative assumption of daily yard activity and indoor dust ingestion by the current residents from the first year sampling data are available to when tailings eroded onto the property. Lead exposures were modeled for 16 years. Exposures to arsenic, cadmium, and zinc were only calculated for 2000-2009, because 2000 is the first year sampling data are available and there is uncertainty regarding the concentration of arsenic, cadmium, and zinc in soil prior to 2000. No children have lived at the property since 1993. Therefore, no exposure scenarios were completed for children for 1993 through present day.

Current Adult Resident (Past Exposure, During Erosion Incident, 2009-2011): 7 days a week, 52 weeks a year, for 2 years – This is a conservative assumption of daily yard activity and indoor dust ingestion by the residents before the tailings were present. The tailings eroded by the first heavy precipitation event in 2009 were on the property for one year. Available documentation is less clear as to when the second erosion of tailings was remediated, but it is known to be within 2011. Because of the unclear timeframe, the total assumed time of exposure is two years.

Future Child and Adult Resident (Current and Future Exposure, after 2011): Seven days a week, 52 weeks a year, for 21 (child) or 33 (adult) years. This is a similar assumption to that used for the current residents pre-erosion incident, except the exposure time is longer because the environmental conditions are assumed to remain unchanged.

7.1.3.2 Scenario Results

Past Child and Adult Resident (Past Exposure, 1970-1993): The IEUBK was used to evaluate past lead exposures in soil and indoor dust for children aged 1 to less than 6 years based on the EPC for lead (512 mg/kg). The projected geometric mean BLL is 4.1 µg/dL and the probability of exceeding 5 µg/dL is 33%. **Table 22** summarizes the IEUBK projections for children exposed at the residence from 1970 to 1993.

The AALM was used to evaluate lead exposures for children aged 6-21 years and for adults aged 21-44 based on the EPC for lead (512 mg/kg), a CTE intake rate (60 mg/day for children ages 6-11 years, 30 mg/day for ages 11 years - adult), 23 years of exposure, and a target BLL of 5 µg/dL. Male and female child residents were projected to have a 97 and 98% probability of exceeding the target BLL, respectively. Adult male residents were projected to have a 9% probability of exceeding the target BLL. **Table 27** summarizes all modeling results for this exposure scenario.

Current Adult Resident (Past Exposure, 1993 - 2009): Based on the EPC for arsenic and cadmium **(Table 13)**, the combined (ingestion and dermal) HQs for RME exposures for adults from 2000-2009 were calculated using PHAST. HQs did not exceed 1 for chronic, intermediate, or acute exposures. Based on these results, IDPH does not believe residential exposures to arsenic and cadmium at this residential property would have caused adverse noncancer health effects.

The AALM was used to evaluate lead exposures for the current adult residents from 1993-2009 based on the EPC for lead (512 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. Male residents were projected to have a 8% probability of exceeding the target BLL. **Table 27** summarizes all modeling results for this exposure scenario.

Current Adult Resident (Past Exposure, During Erosion Incident, 2009-2011): Based on the EPC for arsenic, cadmium, and zinc **(Table 14)**, the combined (ingestion and dermal) HQs for RME exposures for adults was calculated using PHAST. For arsenic and zinc, HQs did not exceed 1 for chronic, intermediate, or acute exposures. Based on these results, IDPH does not believe residential exposures to arsenic and zinc at this residential property would have caused adverse noncancer health effects.

Chronic RME HQs for cadmium exceeded 1 (2.3) for the adult exposure group. The lowest effect level for cadmium (0.00033 mg/kg/day) is very close to the RME dose (0.00023 mg/kg/day) for the adult group. It would take several decades of exposure to cadmium at these doses to build up cadmium in the kidneys and cause harmful effects (ATSDR, 2012a). Residents at this property were likely exposed for only a few years. Therefore, IDPH does not believe adult exposures to cadmium at the residential property caused adverse noncancer health effects. Additionally, the calculated EPC, which was based on the 95th UCL of the mean, exceeded the maximum observed concentration of cadmium. This is usually due to high variability in the data set. However, the 95th UCL was used per ATSDR guidance (ATSDR, 2023). **Table 23** summarizes the HQs for this exposure scenario.

The AALM was used to evaluate lead exposures for the current adult residents based on the EPC for lead (536 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. Male residents were projected to have a 9% probability of exceeding the target BLL. **Table 27** summarizes all modeling results for this exposure scenario.

Adult and Child Resident (Current and Future Exposure, after 2011): Based on the EPC for arsenic **(Table 15)**, the combined HQ for RME exposures for adults and children were calculated using PHAST. HQs exceeded 1 (3.4) for chronic exposures for the birth to less than 1 year exposure group. The highest dose 0.00021 (mg/kg/day) slightly exceeds the lowest effect dose (0.00017 mg/kg/day). This exceedance indicates a possible increased risk of ischemic heart disease or diabetes, which are associated with arsenic exposure. However, it is unclear how accurate these doses are for characterizing health risks because they are based on one sample. The determination of potential risk of the aforementioned health effects was made to be extra protective of human health. **Table 24** summarizes the HQs for this exposure scenario.

No health guideline exists for manganese; therefore, we compared estimated doses in children and adults to known effect levels from human studies. Based on the maximum manganese concentration in soil (3,370 mg/kg), RME exposure doses for adults and children were calculated using PHAST. Doses were 0.1 and 0.093 mg/kg/day for children aged birth to <1 year and 1-<2 years, respectively. These levels exceeded the LOAEL of 0.06 mg/kg/day. Manganese doses in older children approached the LOAEL. The LOAEL is from a human study which suggested a relationship between ingesting the aforementioned dose in drinking water and decreased learning abilities in children after 5 years of exposure. Due to insufficient information on manganese bioavailability in soil, it is unclear how reliable the available LOAEL is for characterizing health risks from soil exposure, as the LOAEL is based on a drinking water study. Bioavailability of manganese in drinking water is estimated to be 5% (NIH, 2021), so it is expected to be low in soil as well. **Table 25** summarizes the doses which exceeded the LOAEL.

The IEUBK was used to evaluate lead exposures in soil and indoor dust for children aged 1 to less than 6 years based on the EPC for lead (190 mg/kg). The projected geometric mean BLL was 2.2 µg/dL and the probability of exceeding the target BLL of 5 µg/dL is 4%. **Table 26** summarizes the IEUBK projections.

The AALM was used to evaluate lead exposures for male and female children aged 6-21 years and adults based on the EPC for lead (190 mg/kg), a CTE intake rate (60 mg/day for children 6-11 years and 30 mg/day for children older than 11 years and adults), and a target BLL of 5 µg/dL. There was less than a 5% chance of exceeding the target BLL for all residents. **Table 27** summarizes all modeling results for this exposure scenario.

7.1.4 Soil Ingestion & Dermal Contact in the Horseshoe Settling Pond and Overland Flow Route

7.1.4.1 Assumptions

This exposure unit was covered with topsoil and fertilized with biosolids in 2014. Thick vegetative ground cover has grown in the area in recent years, but the potential for current and future exposure to mine tailings remains if this land is developed or land use changes occur. Therefore, exposure scenarios were run for two exposed populations (workers and hunters/trespassers) for past exposures based on our knowledge of the area being accessed by these groups. There have been no reports of residents or other property owners accessing the settling pond and overland flow route.

IDPH does not believe the settling pond and overland flow route is accessed by children under 11 years of age and there is no evidence that any children under the age of 11 years live near the area. The following assumptions were made regarding exposure factors for the exposed populations:

Workers: Five days a week, 12 weeks a year, for one year – This is based on remediation work being conducted in the horseshoe settling pond and overland flow route by various contractors over multiple years. Each remedial project lasts days to weeks rather than months to years. Considering the intermittent nature of remedial projects, a total of one year of exposure was used to account for individuals who may have worked on multiple projects throughout one year. This assumption also applies to construction workers who may build a new home on the land, because new home construction also takes less than a year, on average (U.S. Census Bureau, 2021, as reported by Realtor.com, 2022).

Hunters/Trespassers: Two days a week, 39 weeks a year, for 10 years (children) and 33 years (adults) – This is based on the duration of various hunting seasons and times of the year when the ground will be covered by winter precipitation or frozen. IDPH only ran scenarios for adults and children aged 11-21. The same assumption was also conservatively applied to the trespasser population.

7.1.4.2 Scenario Results

Workers: Based on the EPCs for arsenic and cadmium **(Table 16)**, the combined (ingestion and dermal) HQs for low-intensity soil contact exposures for adult workers were calculated using PHAST. HQs for chronic, intermediate, and acute exposures did not exceed 1.

No health guideline exists for manganese; therefore, we compared estimated doses to known effect levels from human studies. The maximum dose of manganese (0.0019 mg/kg/day) was more than 30 times less than the LOAEL of 0.06 mg/kg/day. Based on these results, IDPH does not believe worker exposures to arsenic, cadmium, and manganese in this exposure unit will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures for male and female workers based on the EPC for lead (1,676 mg/kg), an CTE intake rate for low-intensity contact (100 mg/day), and a target BLL of 5 µg/dL. There was less than a 5% chance of exceeding the target BLL for workers. **Table 28** summarizes all modeling results for this exposure scenario.

Hunters/Trespassers: Based on the EPCs for arsenic and cadmium **(Table 16)**, the combined (ingestion and dermal) HQs for CTE and RME scenarios for adults and children (11 to 21 years) were calculated using PHAST. HQs did not exceed 1 for chronic, intermediate, or acute exposures.

No health guideline exists for manganese; therefore, we compared estimated doses to known effect levels from human studies. The maximum dose of manganese (0.0019 mg/kg/day) was

32 times less than the LOAEL of 0.06 mg/kg/day. Based on these results, IDPH does not believe trespasser exposures to arsenic, cadmium, and manganese in this exposure unit will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures for male and female hunters or trespassers based on the EPC for lead (1,676 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. IDPH estimated exposures for children based on exposures from ages 11-21 and adult exposures from ages 21-54. Male adults had a 7% probability of exceeding the target BLL. **Table 28** summarizes all modeling results for this exposure scenario.

7.1.5 Sediment Ingestion & Dermal Contact in the Smallpox Creek

7.1.5.1 Assumptions

There has been one confirmed report of Smallpox Creek being used for fishing. The creek is shallow, narrow, and has a low flow rate; therefore, the creek is not expected to support a large fish population and daily use of the creek for fishing is unlikely. (SulTRAC, 2016). Furthermore, given the creek's characteristics and remote location, the creek also has few points which are easily accessible on foot or by boat, so daily recreation is also unlikely. Therefore, assumptions for sediment ingestion and dermal contact were only developed for anglers (adults aged 21-54) in Smallpox creek: Two days a week, 39 weeks a year, for 33 years. Additionally, a CTE intake rate for sediment was assumed because wading was the only contact anticipated with sediment. Swimming or playing in the creek is not likely.

7.1.5.2 Scenario Results

Based on the EPCs for arsenic, cadmium, and zinc **(Table 17)**, the combined (ingestion and dermal) HQs for a CTE scenario for adults were calculated using PHAST. HQs did not exceed 1 for chronic, intermediate, or acute exposures. Based on these results, IDPH does not believe angler exposures to arsenic, cadmium, and zinc in this exposure unit will result in adverse noncancer health effects.

The AALM was used to evaluate lead exposures to male and female anglers based on the EPC for lead (210 mg/kg), a CTE intake rate (30 mg/day), and a target BLL of 5 µg/dL. There was less than a 5% chance of exceeding the target BLL for anglers. **Table 29** summarizes the modeling results for this exposure scenario.

7.1.6 Surface Water Ingestion in the Smallpox Creek

7.1.6.1 Scenario Assumptions

The creek isn't anticipated to be used for recreation like swimming, canoeing, or playing due to its remote location, low ease of access, and small size. Therefore, scenario assumptions were developed based on incidental ingestion of surface water by anglers. An intake rate of 0.011 liters of creek water per day was assumed based on the upper-confidence limit of intake reported in the most relevant exposure study (Dorevitch, et al, 2011; as reported in EPA Exposure Factors Handbook, 2011). The frequency and duration of surface water ingestion are the same as those for sediment ingestion and dermal contact: Two days a week, 39 weeks a year, for 33 years.

7.1.6.2 Scenario Results

Based on the EPC for arsenic **(Table 18),** the HQ for an RME scenario for adults was calculated using PHAST, and it did not exceed 1 for chronic, intermediate, or acute exposures. Based on these results, IDPH does not believe angler exposures to arsenic in surface water of Smallpox Creek will result in adverse noncancer health effects.

8. Cancer Health Effects

Arsenic and inorganic arsenic compounds are classified as carcinogens by the National Toxicology Program (ATSDR, 2007), and by EPA based on epidemiological evidence (EPA, 2025b). Based on the EPCs for arsenic and an EPA cancer slope factor of 32 $(mg/kg/day)^{-1}$, CRs for each exposure scenario and exposed population were calculated using PHAST. **Table 30** summarizes all CRs that exceeded 1E-6.

The highest calculated CR was 6E-4 (6 in 10,000) for future children living at the residential property who ingest 200 milligrams of soil and dust per day for 21 years. Future adults at the residential property were estimated to have a CR of 2 in 10,000. The EPC used to derive the estimate was 16 mg/kg, which is just above the Jo Daviess County background concentration of arsenic (SulTRAC, 2016). Some uncertainty exists in these estimated cancer risks because the risk is based on one soil sample, which may or may not accurately represent the arsenic concentrations in soil at the residential property. There are also estimated CRs as high as 3E-4 (3 in 10,000) for adult hunters and trespassers who regularly access the tailings pile and 3E-4 for adult property owners who regularly access the woods surrounding the tailings pile. There is also a 2 in 10,000 and 1 in 10,000 cancer risk for older child hunter/trespassers at the tailings pile and older children of property owners of the surrounding wooded properties These areas had higher EPCs of 120 mg/kg and 30 mg/kg, respectively.

People at the residential property, tailings pile, and surrounding wooded properties who are exposed to arsenic in site tailings and soil may have an increased risk of cancer. Available epidemiological evidence sufficiently shows an association between arsenic exposure and increased mortality from bladder and lung cancer. Arsenic comes from multiple manmade and natural sources in the environment which people can be exposed to in water, food, soil, and air. Therefore, exposures to arsenic in site tailings and soil likely do not represent the total exposure to arsenic one may have. CRs may be higher for those who are exposed to other sources of arsenic throughout their life.

The National Toxicology Program and the International Agency for Research on Cancer have also classified cadmium as a known human carcinogen. Cadmium is associated with an elevated risk for lung cancer in occupational settings from inhalation exposure (NTP 2021). However, there is no oral slope factor and therefore no ATSDR CREG has been established for evaluating exposures to cadmium in soil or drinking water. With dust suppression, exposure to cadmium in air is unlikely. We do not have historical air sampling data for cadmium; therefore, IDPH cannot evaluate past inhalation exposure for nearby residents.

9. Summary of Public Health Implications due to Site Related Contaminants

The public health implications due to site-related contaminants are summarized below:

- Ingestion and dermal contact exposure scenarios to lead and arsenic at the tailings pile indicated a past, present, and future health hazard to adult hunters and trespassers.
- Ingestion and dermal contact exposure to lead and arsenic at the surrounding wooded properties indicated a past, present, and future health hazard for adult male property owners.
- Ingestion and dermal contact exposure scenarios to lead at the horseshoe settling pond and overland flow route indicated a past health hazard to adult male hunters and trespassers.
- Ingestion and dermal contact exposure scenarios to lead at the residential property indicated a health hazard for past adult and child residents (1970-1993) as well as the current residents prior to soil remediation in 2012.
- Ingestion and dermal contact exposure scenarios to arsenic and manganese at the residential property indicated a health hazard for future child and adult residents.

Exposure to lead can seriously harm a child's health and cause well-documented harmful effects, such as:

- Damage to the brain and nervous system
- Slowed growth and development
- Learning and behavioral problems
- Hearing and speech problems
- Reduced intelligence, decreased ability to pay attention, and underperformance in school

The health effects of lead exposure are more harmful to young children because their bodies are still developing and growing rapidly. Young children are more likely to be exposed to lead than older children because they tend to put their hands or other objects, which might be contaminated with lead dust, into their mouths. For more information, visit CDC's Childhood Lead Poisoning Prevention Program at https://www.cdc.gov/lead-prevention/prevention/index.html.

Estimated doses were calculated for manganese exposure from soil ingestion at the residential property in the West Area. The estimated doses in children from birth to 2 years exceeded the

LOAEL of 0.06 mg/kg/day. Manganese doses in older children approached the LOAEL. The LOAEL is from a human study which suggested a relationship between ingesting manganese in drinking water and decreased learning abilities in children after 5 years of exposure. This health risk applies to current and future exposures for children at the residential property.

The estimated exposure doses for noncancer health effects are below the MRLs for arsenic for every exposure scenario. Therefore, exposure to these contaminants on the Site is not expected to cause adverse noncancer health effects. However, there is concern for increased cancer risks associated with arsenic exposure at the residential property, tailings pile, and surrounding wooded properties.

10. Evaluation of Health Outcome Data

Per ATSDR guidance for conducting reviews of health outcome data, IDPH queried the availability of data at a demographic scale similar to the size of the exposed population (ATSDR, 2022a). Limited BLL data for ages less than 1 year to 69 were available for the city of Galena. The population of Galena was 3,308 as of the 2020 census (U.S. Census Bureau, 2020). The population expected to be potentially exposed to site-related contaminants is 43. Because the available data are at a demographic scale much larger than the exposed population, there is a chance that an analysis of these data could be affected by exposure misclassification bias (ATSDR, 2022a). IDPH did not evaluate health outcome data for this report due to the potential of such biases.

11. Children's Health Considerations

IDPH recognizes that children are especially sensitive to some contaminants. The health guidelines used in this assessment are protective of children. Children under 6 years of age are particularly at higher risk for exposure to soil contaminants due to the following factors:

- Children are more likely to play outdoors.
- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- The developing body systems of children could be more sensitive to contaminants, particularly if the exposure occurs during critical growth stages.

There are no children currently living at the residential property. Children living at the residential property in the past could have been impacted by soil lead. Future children living at the residential property could be exposed to high concentrations of manganese in soil. However, children under the age of 11 years are not expected to access the rest of the Site. For this reason, IDPH only considered children aged 11-21 when evaluating exposures to contaminants at exposure units other than the residential property.

12. Limitations and Uncertainties

The uncertainties associated with this assessment are likely to be over or underestimating environmental exposures and the associated health hazards. This section highlights the major assumptions and limitations that are specific to this assessment.

- There is limited information to support the exposure frequency and duration assumptions used in this assessment. This is a major source of uncertainty because these assumptions are vital components of the exposure dose calculations and the resulting public health implications of exposure to site-related contamination. IDPH attempted to develop scenarios which were realistic overestimations to be protective of public health. For example, we assumed that property owners access contaminated areas, such as the surrounding wooded properties, five days a week, 39 weeks a year, for 10 years (children) and 33 years (adults) for recreational activities like hiking. Even at this high frequency of use, contact with most contaminants in soil were not a health concern.
- Only one sample was available to evaluate past lead exposures at the residential property. This presents considerable uncertainty as to the confidence of our findings.
- Only maximum concentrations of cadmium were used to assess the risks for noncancer health effects. This is due to the small number of analytical samples collected throughout the Site and cadmium not being statistically adjusted in other investigations where XRF samples were collected. Therefore, the exposure scenario results may have been an over or underestimation of actual exposures.
- There is uncertainty about the accuracy of calculated doses for current and future exposures at the residential property due to a limited number of soil samples. This may have resulted in an over or underestimation of actual doses.
- IDPH used BLL monitoring data from NHANES to establish baseline BLLs for our lead exposure modeling. Because blood lead data are only available for certain years, there are limitations to the accuracy of established baselines. IDPH used the closest available years to estimated time of exposure for those where the proper year was unavailable. However, this may have resulted in an underestimation of exposure risk. Conversely, exposure risks may be overestimated for current and future exposures, as blood lead concentrations have been decreasing over the past two decades, largely due to elimination of leaded gasoline and leaded paints.
- IDPH could not establish a baseline BLL when evaluating exposures using the IEUBK. This resulted in a possible underestimation of health hazards for children living at the residential property in the past.
- The preferred methodology for using the AALM recommends using CTE intake rates for exposure scenarios. This may have resulted in an underestimation of risks for those who may have exposures at RME intake rates.
- Doses of manganese for future children at the residential property may be overestimated. Due to insufficient information on manganese bioavailability in soil, it is unclear how reliable the available LOAEL is for characterizing health risks from soil

exposure, as the LOAEL is based on a drinking water study. Dose estimates are very uncertain because we did not have enough soil samples from the residential yard to reliably estimate an average exposure concentration; therefore, we used the maximum manganese concentration. In addition, the highest manganese concentration was located next to the highway on the edge of the residential property, which reduces the likelihood of regular contact.

13. Conclusions

IDPH and ATSDR have reached the following conclusions regarding exposures to mine tailings, soil, dust, sediments, water, and fish tissue at the Site:

1. *Exposure to lead in soil or mine tailings at the tailings pile, surrounding wooded properties, and horseshoe settling pond and overland flow route may pose a past, present, and future health hazard to property owners, hunters, and trespassers who access this area* frequently. *IDPH concludes that children under the age of 11 years are not likely to be exposed because they are unlikely to access these remote areas and terrain.* Lead modeling indicated a greater than 5% chance that exposures to lead in soil and tailings would cause BLLs in adult males at the tailings pile, surrounding wooded properties, and horseshoe settling pond and overland flow route, and adult females at the tailings pile to exceed the target BLL used by IDPH. These exceedances increase the likelihood of harmful health effects from lead exposure. The nervous system is the main target for adverse effects of lead in adults. Long-term exposure can result in decreased learning, memory, and attention. It can also increase blood pressure, particularly in middle-aged and older individuals, and cause hardening of the arteries known as arteriosclerosis, which reduces blood flow to organs, including the heart. Lead exposure can cause changes in enzyme activity in the blood, resulting in decreased hemoglobin and platelet counts and may result in anemia (reduced red blood cells). Lead exposure also can damage the kidneys, resulting in protein in the urine, and alter the immune system reducing the body's ability to fight off infections.

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2. *Past exposure to lead in soil, indoor dust, and tailings may have harmed the health of children and adults at the residential property.* Evidence shows that the soil at the residential property was contaminated with lead when heavy rains caused erosion and runoff from the tailings pile in the East Area. The property may have been contaminated as far back as 1970. Modeling indicated a greater than 5% chance that exposures to lead in soil at various concentrations detected at the residential property could have caused or could cause blood lead concentrations in male and female children and adult males to exceed the target BLL used by IDPH. This exceedance increased the likelihood of harmful effects in children and adults who lived at the residence.

   Children are the most at risk of adverse health effects from lead exposure and no safe level of lead exposure has been identified. Exposure to lead can seriously harm a child's health and cause well-documented harmful effects, such as:

- Damage to the brain and nervous system
- Slowed growth and development
- Learning and behavioral problems
- Hearing and speech problems

Effects of lead exposure can include reduced intelligence, decreased ability to pay attention, and underperformance in school. These exceedances also increase the likelihood of the harmful health effects for adults which were detailed in the Conclusion 1.

3. *Exposure to arsenic at the residential property, tailings pile, and surrounding wooded properties could result in increased cancer risks.* IDPH estimated cancer risks for children and adults who are exposed to arsenic at the residential property (used as a primary residence), tailings pile, and surrounding wooded properties which were at or above 1 in 10,000. IDPH considers theoretical cancer risks at or above 1 in 10,000 to be an indication of increased chances for cancers for those exposed.

4. *Future exposure to arsenic or manganese in soil could affect the health of children living at the residential property.* One sample on the residential property had an arsenic concentration slightly above the background concentration in Jo Daviess county. Estimated exposure doses exceeded the LOAELs from human exposure studies which showed an association between arsenic exposure and increased instances of ischemic heart disease and diabetes. The exceedance of the LOAELs indicates a possible increased risk of these adverse health effects for future children living at the residential property. However, it is unclear how accurate these doses are for characterizing health risks because they are based on one sample. With these limitations in mind, the estimated exposure dose was used as a conservative measure to protect human health.

   One soil sample on the residential property had a manganese concentration that would result in an exposure dose that exceeds the lowest observed adverse effect level LOAEL from a study of children exposed to high levels of manganese in drinking water. Regular exposure to this manganese concentration could be harmful to young children. This sample, however, was located on the edge of the property near the highway and young children are not likely to play in this area. In addition, the bioavailability of manganese in this soil is unknown, so it is unclear how accurate this estimated exposure dose is for characterizing health risks. With these limitations in mind, the estimated exposure dose was used as a conservative measure to protect human health.

5. *Exposure to sediment and surface water contamination in Smallpox Creek does not pose a health hazard to people using the creek for wade fishing.* There are sediment and surface water sampling data for the creek. However, it is a small, low-flow creek which is not expected to be used frequently for recreational use. As such, there have not been reports of people using the creek for swimming, canoeing, wading, or other instream

recreation. Nevertheless, exposure modeling was conducted to assess past reports of fishing and potential present and future access to the creek as a conservative measure. All estimates of exposure produced results which indicated adverse health effects were not likely.

6. *Ingestion and dermal contact with cadmium and zinc in East Area and West Area soil and tailings is not expected to pose a noncancer health hazard to any exposure group.* Estimated exposure doses for all exposure groups considered in this assessment are below levels which are expected to cause harmful noncancer health effects.

7. *There is not enough information for IDPH to determine if windblown dust from the Bautsch-Gray Mine Site could have harmed people's health in the East Area or West Area in the past.* While exposures might have occurred, there are insufficient data to assess possible health effects. EPA did limited dust sampling during remedial activities and did not detect contaminants above levels of concern. However, samples were collected during times when dust sampling was not ideal (e.g., after rainfall) and limited samples were taken during other sampling events during dry weather conditions.

8. *There is not enough information for IDPH to determine if past fish consumption could have harmed the health of anglers.* The available fish tissue sampling data are insufficient in both quantity and quality. Therefore, the data could not be used to assess exposure reliably. IDPH believes this is not a complete pathway for present or future anglers because, as the creek does not appear to produce enough fish of edible size to provide regular meals.

9. *There is not enough information for IDPH to determine if groundwater could have harmed the health of the residents at the residential property.* Current residents refrained from using the well water since moving into the property in 1993. Residents prior to 1993, particularly those who initially had the well drilled, are expected to have used the water. However, IDPH has no information to confirm this and has no pre-1993 data to assess past exposures.

10. *There is not enough information for IDPH to determine if mine tailings hauled off-site and used for driveways and fill could pose a health hazard to exposed individuals.* Community members expressed this concern during a meeting held by EPA in 2010. Without knowing when, where, or how the mine tailings were used, and lacking sample data to evaluate, it is not possible to assess the risk.

14. Recommendations

IDPH recommends that:

- Children should not be allowed on the tailings pile.
- Children and adults known to regularly access the tailings pile are encouraged to discuss blood lead testing with their health care provider.

- People who live in or access the West and East Areas may consider the following best practices for reducing exposure to contaminants in soil:
    - Wear gloves when working with soil and wash hands before eating or drinking.
    - Discourage children from eating soil. Don't let children play in soil known or suspected to be contaminated.
    - Wash all produce grown in the garden using running water. Discard the outer leaves of greens before washing. Peel root vegetables that were in direct contact with soil.
    - Cover bare dirt patches with mulch, grass, or other ground cover; especially in areas where children play.
    - Vacuum carpeting, rugs, and upholstery often to keep dust from accumulating. Wet mop and wet wipe surfaces in the home, especially in areas where children play.
    - Remove shoes when going inside and leave outdoor shoes in the garage or the entryway. Separately wash heavily soiled clothes.
- The owner of the residential property is highly encouraged to contact EPA if mine tailings overflow onto the property again in the future. Future residents may also consider blood lead testing for children should any erosion events occur, and if they come in regular contact with the tailings.
- EPA may consider adding a note on the deed to the property (or properties) which comprise(s) the horseshoe settling pond and overland flow route exposure units to restrict future landowners from building housing on this land.
- EPA may consider including signage on the perimeter of the tailings pile which alerts individuals to heavy metals contamination and the risk of harmful health effects.

15. Public Health Action Plan

The Public Health Action Plan provides a plan of action designed to reduce and prevent exposure to hazardous substances in the environment. This plan includes a description of actions that will be taken by IDPH, in collaboration with other agencies, to implement the recommendations outlined in this document.

Public health actions that will be taken in the future:

- IDPH will produce a fact sheet about the Site and our findings to be made available to the residents of Galena. We will also coordinate with EPA for a possible community engagement activity in Galena, such as a town hall, Soil Screening Health, Outreach, and Partnership (soilSHOP), or public availability session.
- IDPH will be available to evaluate any new environmental sampling data as it becomes available.
- IDPH will continue to coordinate with ATSDR and EPA to address community health concerns and questions as they arise.
- IDPH received additional soil sampling data from EPA late in the PHA process. These

additional data do not change the conclusions derived in this PHA. Therefore, IDPH will evaluate these data in a future report.

Report Preparation

The Illinois Department of Public Health (IDPH) prepared this Public Health Assessment for the Bautsch-Gray Mine site, located in Jo Daviess County, Illinois. This publication was made possible by a cooperative agreement [CDC-RFA-TS-23-0001] with the federal Agency for Toxic Substances and Disease Registry (ATSDR). IDPH evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by IDPH.

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16. References

1. [ATSDR] Agency for Toxic Substances and Disease Registry. (2005). *Toxicological Profile for Zinc*. https://www.atsdr.cdc.gov/toxprofiles/tp60.pdf

2. [ATSDR] Agency for Toxic Substances and Disease Registry. (2007). *Toxicological Profile for Arsenic*. https://www.atsdr.cdc.gov/toxprofiles/tp2.pdf

3. [ATSDR] Agency for Toxic Substances and Disease Registry. (2012a). *Toxicological profile for Chromium*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

4. [ATSDR] Agency for Toxic Substances for Disease Registry. (2012b). *Toxicological Profile for Manganese*. https://www.atsdr.cdc.gov/toxprofiles/tp151.pdf

5. [ATSDR] Agency for Toxic Substances and Disease Registry. (2012c). *Toxicological Profile for Cadmium*. https://www.atsdr.cdc.gov/toxprofiles/tp5.pdf

6. [ATSDR] Agency for Toxic Substances and Disease Registry. (2020). *Toxicological Profile for Lead*. https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf

7. [ATSDR] Agency for Toxic Substances and Disease Registry. (2022a). *Public health assessment guidance manual*. Atlanta: US Department of Health and Human Service. https://www.atsdr.cdc.gov/pha-guidance/index.html.

8. [ATSDR] Agency for Toxic Substances and Disease Registry (April 14, 2022b). *Exposure Point Concentration Guidance for Non-Discrete Sampling.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. https://www.atsdr.cdc.gov/pha-guidance/resources/Non-Discrete-Sampling-EPC-Guidance-508.pdf

9. [ATSDR] Agency for Toxic Substances and Disease Registry. (2022c). ATSDR Newsletter for Health Assessors Including APPLETREE Partners. ATSDR. https://www.atsdr.cdc.gov/pha-guidance/resources/ATSDR-Newsletter-for-Health-Assessors-January-2022-508.pdf

10. [ATSDR] Agency for Toxic Substances and Disease Registry. (2022d). *CVs and Health Guidelines: Manganese*. Public Health Site Assessment Tool. http://www.atsdr.cdc.gov

11. [ATSDR] Agency for Toxic Substances and Disease Registry. (2023). *Exposure Point Concentration Guidance for Discrete Sampling*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

12. Dorevitch, S., Panthi, S., Huang, Y., Li, H., Michalek, A. M., Pratap, P., Wroblewski, M., Liu, L., Scheff, P. A., & Li, A. (2011). Water ingestion during water recreation. *Water Research*, *45*(5), 2020-2028. https://doi.org/10.1016/j.watres.2010.12.006

13. Heidenry, M. (2022, October 5). *How Long Does it Take to Build a House?* Realtor.com. https://www.realtor.com/advice/buy/how-long-does-it-take-to-build-a-house/

14. [IEPA] Illinois Environmental Protection Agency. (2001). *CERCLA Integrated Assessment for Bautsch-Gray Mine, ILN#000508088, Galena, Illinois. Springfield, IL.*

15. [IEPA] Illinois Environmental Protection Agency. (2002). *CERCLA Expanded Site Inspection for Bautsch-Gray Mine, ILN#000508088, Galena, Illinois. Springfield, IL.*

16. [NIH] National Institutes of Health. (2021). *Manganese*. https://ods.od.nih.gov/factsheets/Manganese-HealthProfessional/

17. Soilworks. (n.d.). *Soiltac® – Soilworks*. Soilworks – Soil Stabilization & Dust Control. https://soilworks.com/soiltac/

18. SulTrac. (2016). *Final Remedial Investigation Report for Bautsch-Gray Mine Site Jo Daviess County, IL*.

19. Tetra Tech. (2014). *Draft Trip Report for Bautsch-Gray Mine Site*.

20. U.S. Census Bureau. (2020). *Galena city, Illinois*. https://data.census.gov/profile/Galena_city,_Illinois?g=160XX00US1728300

21. [CDC] U.S. Centers for Disease Control and Prevention. (2024, April 2). *CDC updates blood lead reference value*. Childhood Lead Poisoning Prevention. https://www.cdc.gov/lead-prevention/php/news-features/updates-blood-lead-reference-value.html?CDC_AAref_Val=https://www.cdc.gov/nceh/lead/news/cdc-updates-blood-lead-reference-value.html

22. [EPA] United States Environmental Protection Agency. Technical Review Workgroup for Lead. (2021). *User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK)*. https://semspub.epa.gov/work/HQ/400700.pdf

23. [EPA] United States Environmental Protection Agency. (1995). *Chemical Assessment Summary of Manganese*. https://iris.epa.gov/ChemicalLanding/&substance_nmbr=373

24. [EPA] United States Environmental Protection Agency. (2011). *Exposure Factors Handbook*.

25. [EPA] United States Environmental Protection Agency. (2012a). *Fact Sheet. Additional Cleanup Planned at Contaminated Site*.

26. [EPA] United States Environmental Protection Agency. (2012b). *Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil*.

27. USEPA. https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.scs&id=0510407&doc=Y&colid=30247®ion=05&type=SC

28. [EPA] United States Environmental Protection Agency . (2014). *Community Involvement Plan*. https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.scs&id=0510407&doc=Y&colid=30247®ion=05&type=SC

29. [EPA] United States Environmental Protection Agency. (2022). *Information about public water systems*. https://www.epa.gov/dwreginfo/information-about-public-water-systems

30. [EPA] United States Environmental Protection Agency. (2024). *All ages lead model (AALM)*. US EPA. https://www.epa.gov/land-research/all-ages-lead-model-aalm

31. [EPA] United States Environmental Protection Agency. (2025a). *Residential soil lead directive for CERCLA sites and RCRA hazardous waste cleanup facilities*. US EPA. https://www.epa.gov/superfund/residential-soil-lead-directive-cercla-sites-and-rcra-hazardous-waste-cleanup-facilities#:~:text=On%20October%2016%2C%202025%2C%20OLEM,improvements%20to%20accelerate%20response%20actions

32. [EPA] United States Environmental Protection Agency. (2025b). *IRIS Toxicological Review of Inorganic Arsenic*. Retrieved from EPA website: https://iris.epa.gov/static/pdfs/0278_summary.pdf

Appendices

Appendix A: Brief Summary of ATSDR's Public Health Assessment (PHA) Process

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:

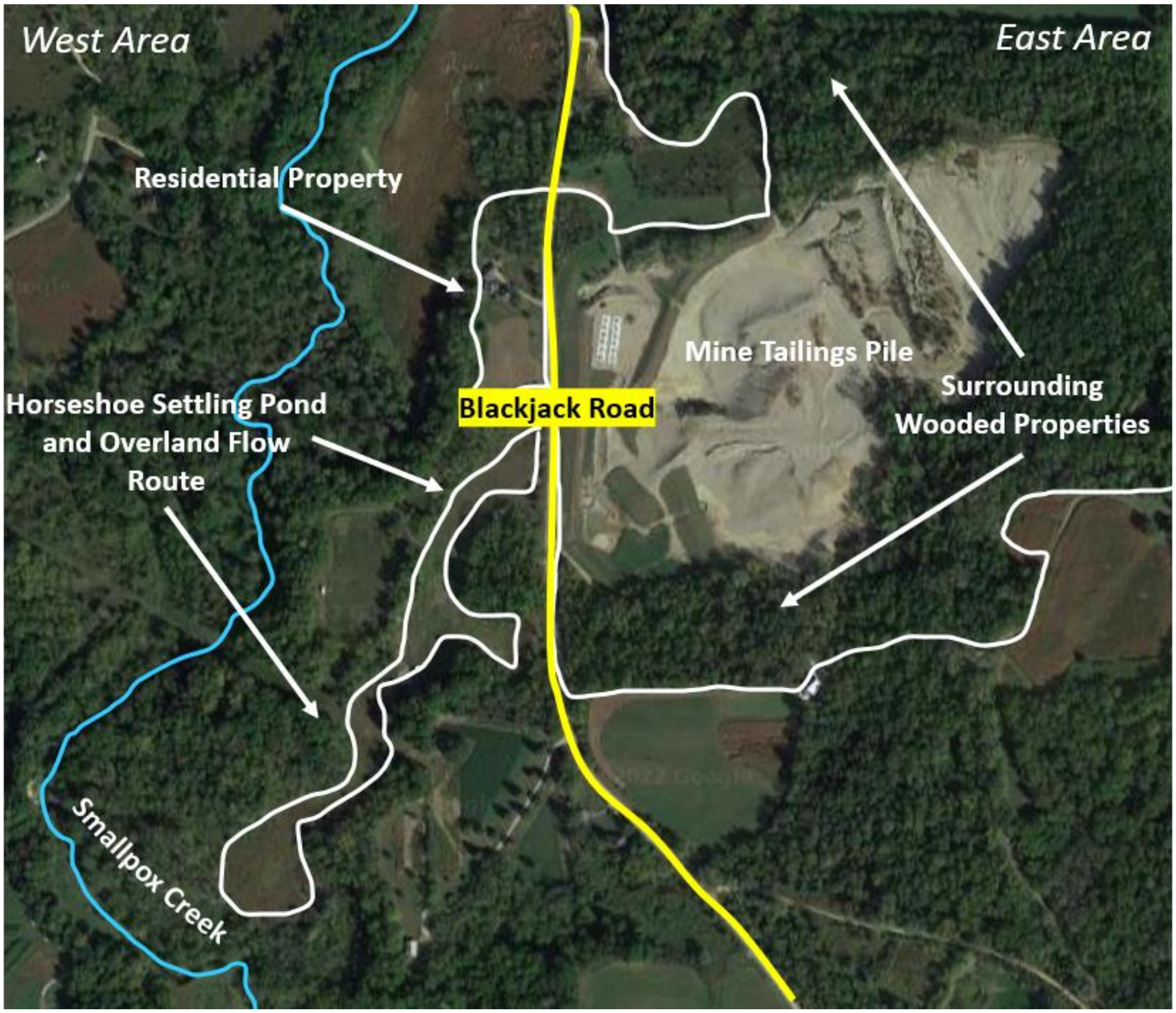
- Establishes communication mechanisms, including engaging communities at the beginning of site activities and involves them throughout the process to respond to their health concerns. Collects many different kinds of site information.
- Obtains, compiles, and evaluates the usability and quality of environmental 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 require 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 noncancer 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. Readers can also refer to ATSDR's Public Health

Assessment Guidance Manual for all information related to the stepwise PHA process.

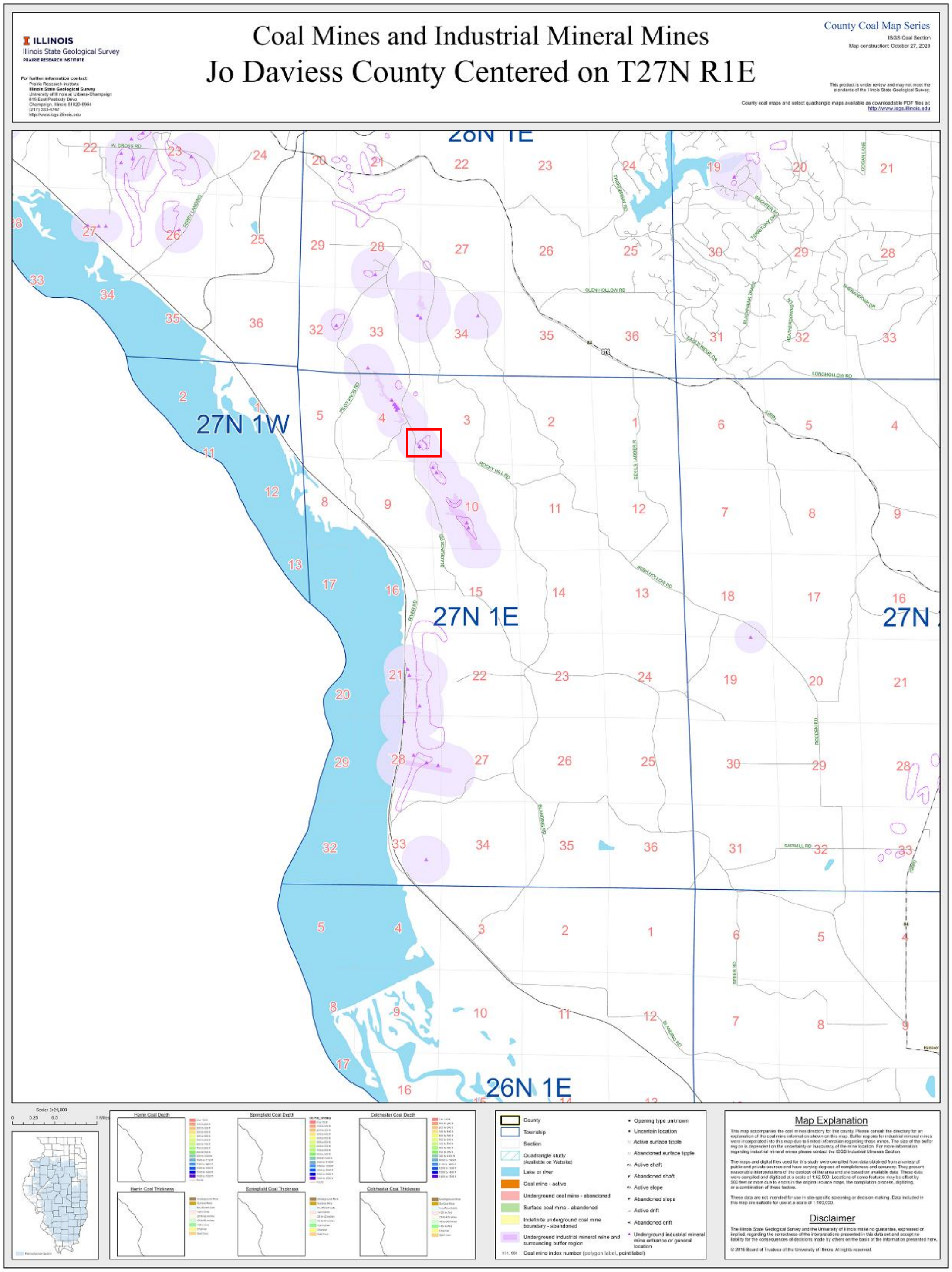
Appendix B: Figures

Figure 1: Bautsch-Gray Mine Site



Bautsch-Gray Mine Site. Image courtesy of Google. 2022.

Figure 2: Coal Mines and Industrial Mineral Mines in Jo Daviess County

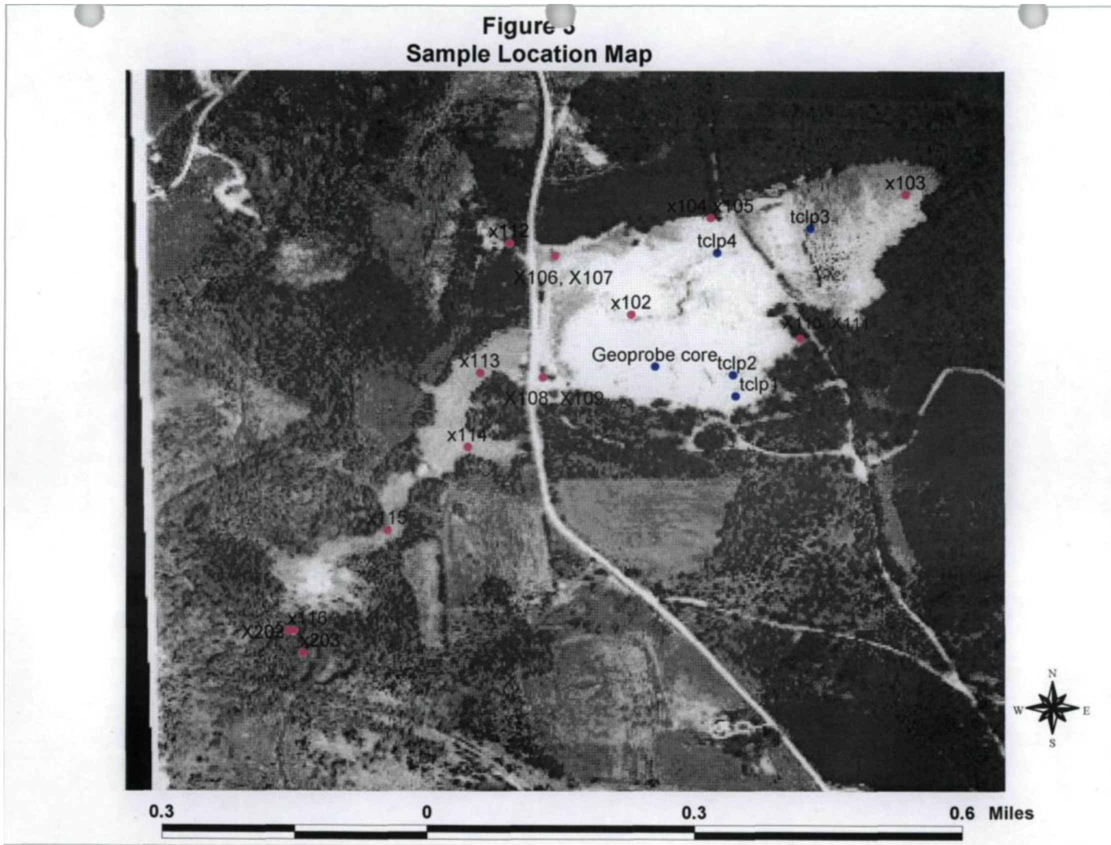


The purple areas show where industrial mineral mines are located. The red box is the Site's location. Note that purple fills this box, which indicates that mineral mines, such as those with lead-bearing ore, make up the geology of the Site. Illinois State Geological Survey, Coal Mines and Industrial Mineral Mines, October 2023

Figure 3: Tailings Pile, facing east

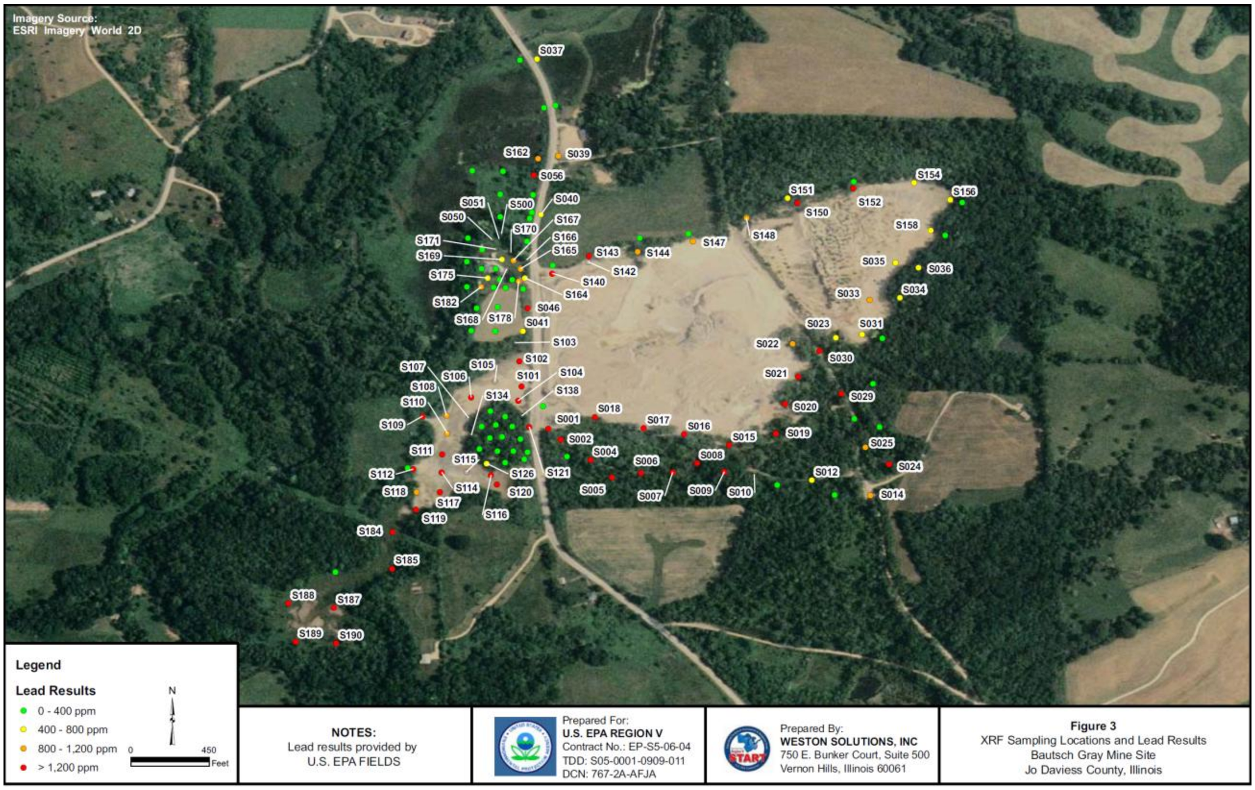
Aaron Burlingham. Personal photography. October 2022.

Figure 4: 2000 Initial Assessment Soil Sampling Locations



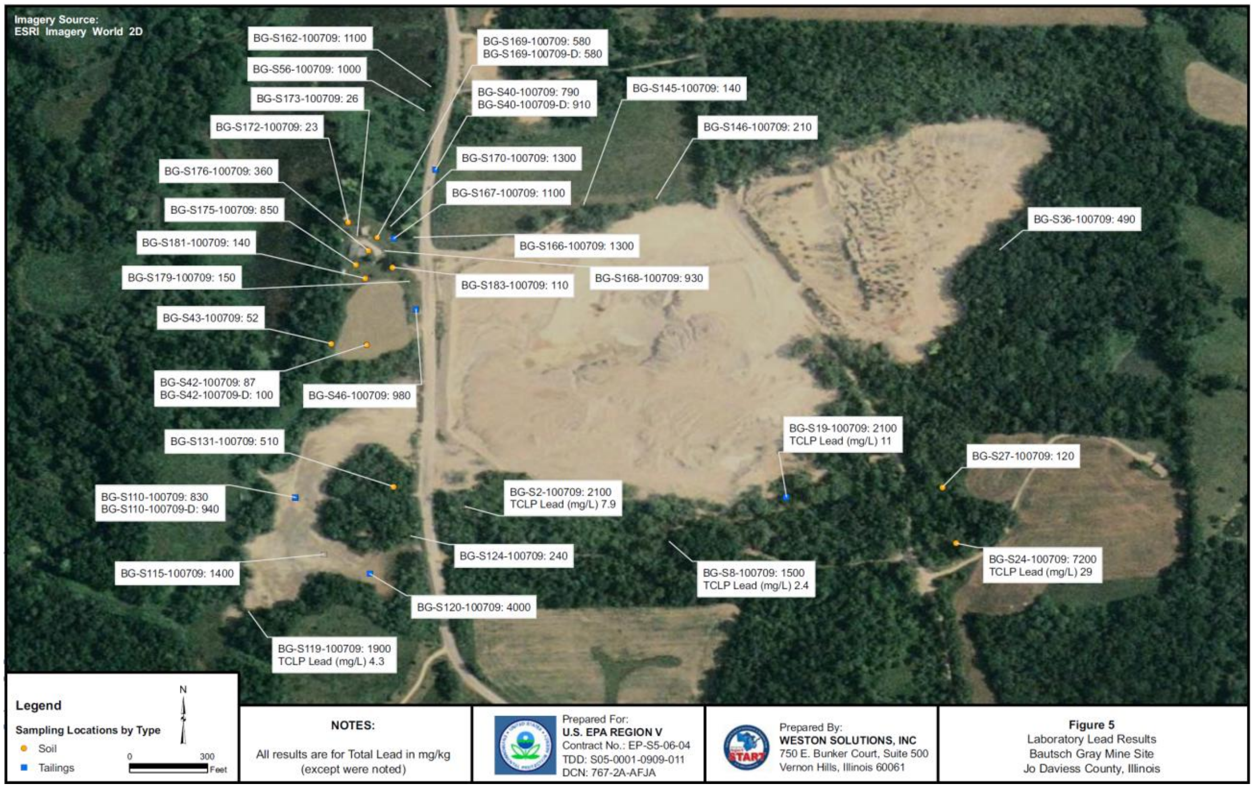
IEPA. Integrated Assessment for Bautsch-Grey Mine, Galena, Illinois. June 2001

Figure 5: 2009 Site Assessment XRF Sampling Locations



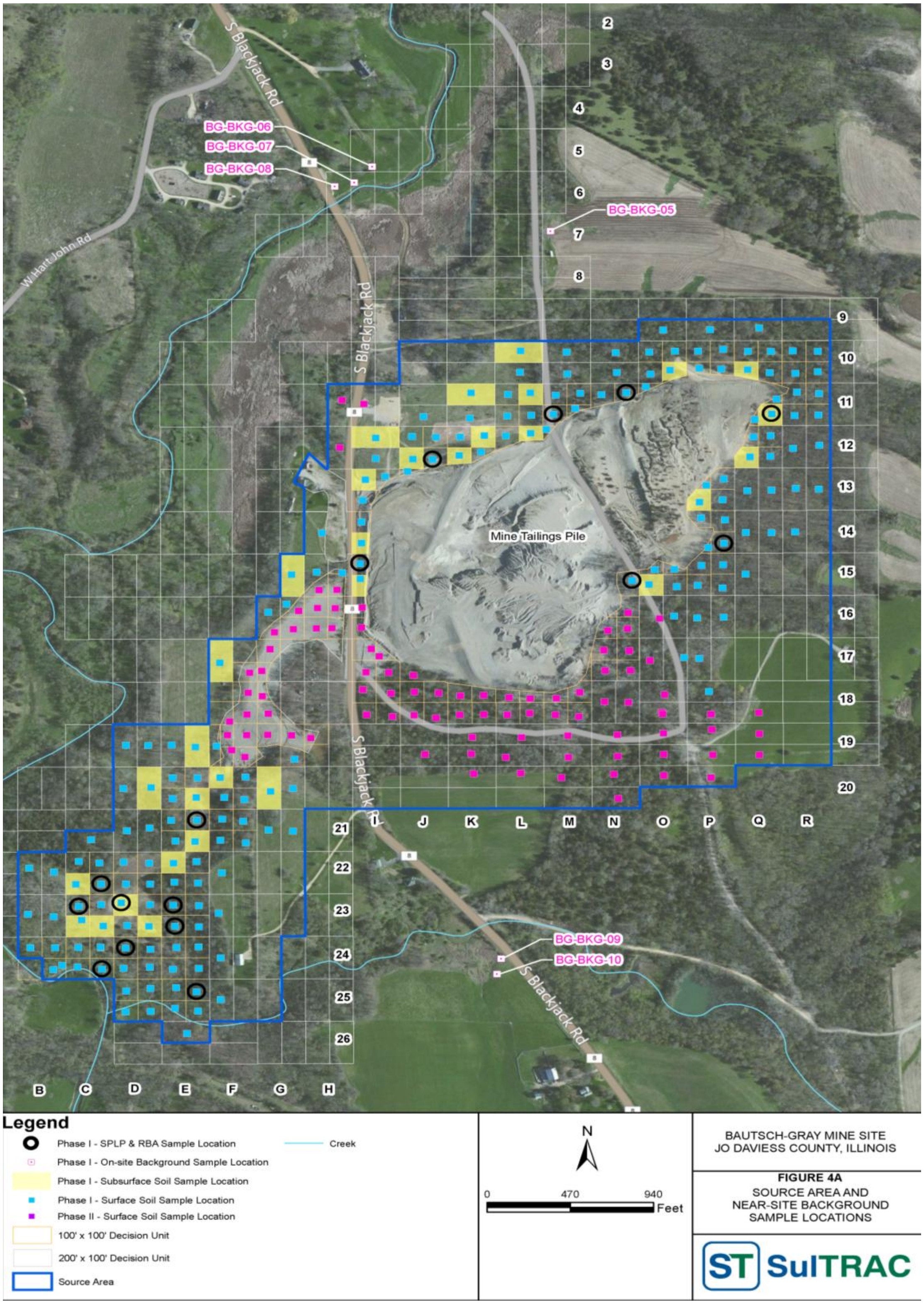
Weston Solutions, Inc. Site Assessment Report for Bautsch Gray Mine Site, Jo Daviess County, IL. March 2010.

Figure 6: 2009 Site Assessment Analytical Sampling Locations



Weston Solutions, Inc. Site Assessment Report for Bautsch Gray Mine Site, Jo Daviess County, IL. March 2010.

Figure 7: 2014 Remedial Investigation Soil Sampling Locations



SulTrac. Final Remedial Investigation Report for Bautsch-Gray Mine Site Jo Daviess County, IL. June 2016.

Figure 8: 2014 Remedial Investigation Fish Tissue Sampling Locations

SulTrac. Final Remedial Investigation Report for Bautsch-Gray Mine Site Jo Daviess County, IL. June 2016.

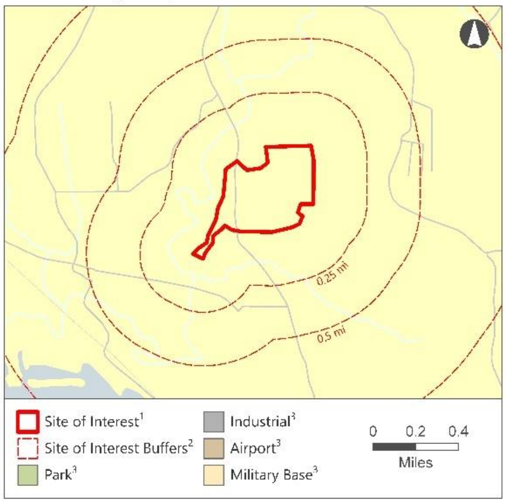
Appendix C: GRASP Maps

GRASP Map - General Site Profile

Bautsch-Gray Mine
Galena, Jo Daviess County, IL

INTRODUCTORY MAP SERIES
GENERAL SITE PROFILE
EPA FACILITY ID ILN000510407

Site Vicinity Map

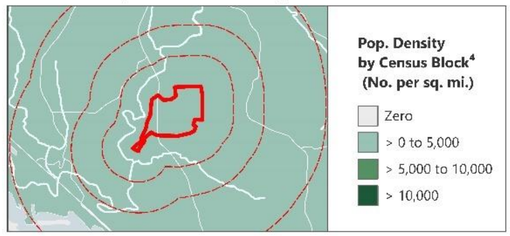


The **General Site Profile Map** depicts the hazardous waste site of interest, along with any airport, industrial, military, or park land uses. It also provides community demographic and housing statistics.

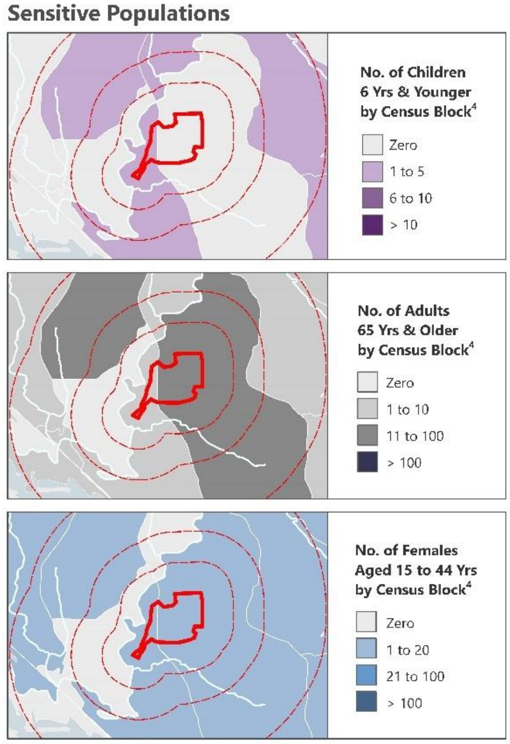
Demographic Statistics[4,5]
Within 0.5 Miles buffer of site boundary

Measure	2010	2020	Change
Total Population	36	43	+19%
White Alone	35	40	+14%
Black Alone	0	0	+0%
Am. Indian/Alaska Native Alone	1	0	-100%
Asian Alone	0	0	+0%
Native Hawaiian & Other Pacific Islander Alone	0	0	+0%
Some Other Race Alone	0	0	+0%
Two or More Races	0	1	N/A
Hispanic or Latino[6]	0	2	N/A
Children Aged 6 and Younger	0	2	N/A
Adults Aged 65 and Older	12	13	+8%
Females Aged 15 to 44	3	3	+0%
Housing Units	22	23	+4%
Housing Units Pre 1950	22	18	-18%

General Population Density



Sensitive Populations



Data Sources: [1]ATSDR GRASP, [2]ATSDR GRASP, [3]TomTom 2021Q3, [4]US Census 2020 Demographic and Housing Characteristics, **Notes:** [5]Calculated using area-proportion spatial analysis method, [6]Individuals identifying origin as Hispanic or Latino may be of any race. **Coordinate System:** Coordinate System used for all map panels is NAD 1983 StatePlane Illinois West FIPS 1202 Feet

ATSDR Agency for Toxic Substances and Disease Registry

GRASP Geospatial Research, Analysis, and Services Program

PRJ ID 13722 | AUTHOR Bethany Foust

FINAL - FOR PUBLIC RELEASE

1/15/2025

GRASP Map - Non-English Speakers

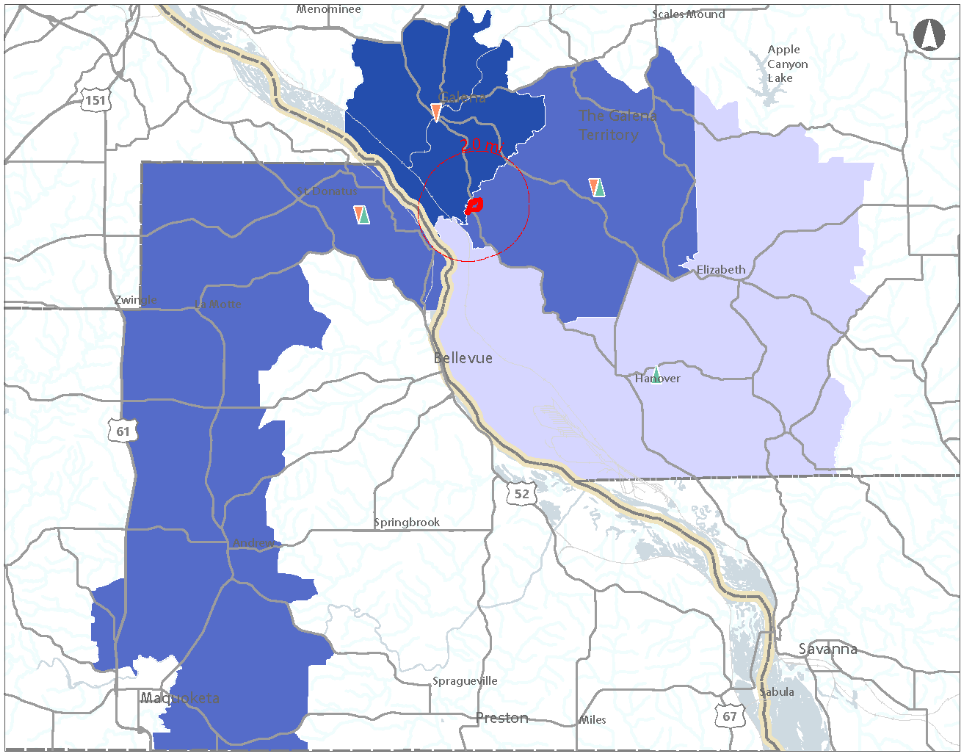
Bautsch-Gray Mine

Galena, Jo Daviess County, IL

INTRODUCTORY MAP SERIES

NON-ENGLISH LANGUAGE SPEAKERS

EPA FACILITY ID ILN000510407



Percent of Population who speaks English Less than Very Well[3]

0 0.5 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Miles

Site of Interest[1] Site of Interest Buffer[2]

The Most Prevalent Language Spoken Other Than English Map depicts the distribution of the estimated percent of the population aged 5 and older who speak **Spanish** and also speak English less than very well residing in the surrounding community near the site of interest. The distribution of languages spoken in and around a site is critical to effective health communication.

Due to relatively small sample sizes in the ACS, the **Margin of Error (MOE)** can be quite large, especially for small geographic areas such as census tracts, block groups, and even many small towns. In many instances the MOE can be larger than the actual estimate. Another potential issue is the time span over which the five-year ACS samples are collected.

Percent of People 5 Yrs & Older Who Speak Spanish and Speak English Less Than Very Well by Census Tract[3]

- 0% - 0.26%
- 0.27% - 0.53%
- 0.54% - 1.60%
- 1.61% - 3.67%
- 3.68% - 9.38%

Potential Change in Class Due To Margin of Error

- Higher data class
- Higher or lower data class
- Lower data class

Most Predominant Languages Spoken among those who Speak English Less Than Very Well[3]

Census tracts intersecting 2-mile buffer around site of interest boundary

Language	Estimate (± MOE)
Spanish	115 (± 60)
Gujarati	54 (± 58)
Polish	8 (± 22)
German	8 (± 21)
Other Slavic languages	7 (± 22)
Mon-Khmer, Cambodian	0 (± 21)

Data Sources: [1]ESRI,[2]ATSDR GRASP, [3]US Census American Community Survey 5 Year Estimates 2012. **Notes:** MOE calculated using aggregated count method. **Coordinate System:** NAD 1983 StatePlane Illinois West FIPS 1202 Feet

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GRASP Geospatial Research, Analysis, and Services Program

PRJ ID 06316 | **AUTHOR** Mark Deka 10/25/2022

Appendix D: Exposure Point Concentrations and Dose Calculations

Table 11: Exposure Point Concentrations (EPCs) of Tailings Pile Contaminants in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	95UCL of the mean	120
Cadmium	Maximum detection	95
Lead	Arithmetic mean	2,445
Zinc	95UCL of the mean	39,488

Table 12: Exposure Point Concentrations (EPCs) of Surrounding Wooded Properties Contaminants in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	95UCL of the mean	30
Cadmium	Maximum detection	120
Lead	Arithmetic mean	751
Manganese	95UCL of the mean	1,311
Zinc	95UCL of the mean	4,623

Table 13: Exposure Point Concentrations (EPCs) of Residential Property Contaminants (Past, 1993-2009) in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	Maximum detection	32
Cadmium	Maximum detection	5.3
Lead	Maximum detection	512

Table 14: Exposure Point Concentrations (EPCs) of Residential Property Contaminants (Erosion Incident, 2009-2011) in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	95UCL of the mean	30
Cadmium	95UCL of the mean	210
Lead	Arithmetic mean	536
Zinc	95UCL of the mean	15,614

Table 15: Exposure Point Concentrations (EPCs) of Residential Property Contaminants (Current and Future, after 2011) in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	Maximum detection	16
Lead	Arithmetic mean	190
Manganese	Maximum detection	3,370

Table 16: Exposure Point Concentrations (EPCs) of Horseshoe Settling Pond and Overland Flow Route Contaminants in Milligrams per Kilogram (mg/kg) of Soil

Contaminant	EPC Type	EPC
Arsenic	95UCL of the mean	30
Cadmium	Maximum detection	29
Lead	Arithmetic mean	1,676
Manganese	95UCL of the mean	1,385

Table 17: Exposure Point Concentrations (EPCs) of Smallpox Creek Contaminants in Milligrams per Kilogram (mg/kg) of Sediment

Contaminant	EPC Type	EPC
Arsenic	95UCL of the mean	8
Cadmium	95UCL of the mean	18
Lead	Arithmetic mean	209
Zinc	95UCL of the mean	8,435

Table 18: Exposure Point Concentrations (EPCs of Smallpox Creek Contaminants in Micrograms per Liter (µg/L) of Surface Water

Contaminant	EPC Type	EPC
Arsenic	Maximum detection	1.8

Table 19: Tailings Pile – All Ages Lead Model Results – Site Workers, Hunters, and Trespassers*

Exposure Group	Baseline BLL (µg/dL)†	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Workers (Male)	1.3	2,445	Arithmetic mean	2.2	16	4
Workers (Female)	0.97	2,445	Arithmetic mean	2.2	16	4
Hunters/Trespassers (Child (11-21), Male)	1.5	2,445	Arithmetic mean	1.6	5	1
Hunters/Trespassers (Child (11-21), Female)	1.5	2,445	Arithmetic mean	1.9	10	2
Hunters/Trespassers (Adult, Male)	2.0	2,445	Arithmetic mean	2.7	29	9‡
Hunters/Trespassers (Adult, Female)	1.4	2,445	Arithmetic mean	2.6	17	5‡

Source: [Weston Solutions, 2010]
Abbreviations: EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
* The calculations in this table were generated using EPA's All Ages Lead Model v3.0.
† Source: NHANES Biomonitoring Data Tables for Environmental Chemicals, Blood Lead (1999 – 2010) and (2011 – 2018)
‡ Indicates values which exceed 5%, which ATSDR considers a health hazard.

Table 20: Surrounding Wooded Properties: Combined ingestion and dermal exposure doses for chronic exposure to cadmium in soil at 120 mg/kg along with noncancer hazard quotients – Property Owners*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	Exposure Duration (years)
11 to < 16 years	0.00012	1.2 †	5
16 to < 21 years	9.9E-05	0.99	5
Total Child	-	-	10
Adult	5.3E-05	0.53	33

Source: [Weston Solutions, 2010]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years
* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0001 mg/kg/day. Assumed activity includes walking/hiking.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table 21: Surrounding Wooded Properties – All Ages Lead Model Results – Property Owners, Hunters/Trespassers, and Site Workers*

Exposure Group	Baseline BLL (µg/dL)†	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Property Owners (Child (11-21), Male)	1.5	751	Arithmetic mean	1.5	3	1
Property Owners (Child (11-21), Female)	1.5	751	Arithmetic mean	1.8	8	1
Property Owners (Adult, Male)	2.0	751	Arithmetic mean	2.5	25	8‡
Property Owners (Adult, Female)	1.4	751	Arithmetic mean	2.1	13	3
Hunters/Trespassers (Child (11-21), Male)	1.5	751	Arithmetic mean	1.3	1	0.2
Hunters/Trespassers (Child (11-21), Female)	1.5	751	Arithmetic mean	1.5	4	1
Hunters/Trespassers (Adult, Male)	2.0	751	Arithmetic mean	2.2	17	4
Hunters/Trespassers (Adult, Female)	1.4	751	Arithmetic mean	1.7	6	1

Exposure Group	Baseline BLL (µg/dL)[†]	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Workers (Male)	1.3	751	Arithmetic mean	1.6	5	1
Workers (Female)	0.97	751	Arithmetic mean	1.4	2	0.3

Source: [SulTRAC, 2016; Weston Solutions, 2010]
Abbreviations: EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
[*] The calculations in this table were generated using EPA's All Ages Lead Model v3.0. Property owner = Those who live own and hike on their wooded property; Hunter/Trespasser = Those who hunt in the exposure unit. Same exposure frequency is assumed for those who trespass; Site Worker = Those performing remedial work on the exposure unit.
[†] Source: NHANES Biomonitoring Data Tables for Environmental Chemicals, Blood Lead (1999 – 2010) and (2011 – 2018)
[‡] Indicates values which exceed 5%, which ATSDR considers a health hazard.

Table 22: Residential Property – IEUBK Results – Past Child Residents (1970-1993)*

Child Age (years)	Lead EPC (mg/kg)	EPC Type	Projected Geometric Mean BLL (µg/dL)	Probability of Exceeding 5 µg/dL (%)
1 to < 6 (12-72 months)	512	Maximum detection	4.1	33[†]

Source: [IEPA, 2001]
Abbreviations: IEUBK = Integrated Exposure Uptake Biokinetic model; EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
[*] The calculations in this table were generated using EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model v2.0.
[†] Indicates values which exceed 5%, which ATSDR considers a health hazard.

Table 23: Residential Property (Past Exposure, 2009-2011) – Adult Resident: Combined ingestion and dermal exposure doses for chronic exposure to cadmium in soil at 210 mg/kg*

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
Adult	9.2E-05	0.92	-	0.00023	2.3 [†]	-	2

Source: [Weston Solutions, 2010]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years
[*] The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0001 mg/kg/day.
[†] Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table 24: Residential Property (Current and Future Exposure) Child and Adult Resident: Combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 16 mg/kg*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
Birth to < 1 year	0.00009	1.5†	-	0.00021	3.4†	-	1
1 to < 2 years	0.00009	1.5†	-	0.00019	3.1†	-	1
2 to < 6 years	0.00005	0.8	-	0.00012	2.1†	-	4
6 to < 11 years	0.00003	0.5	-	0.00007	1.2†	-	5
11 to < 16 years	0.00001	0.2	-	0.00003	0.4	-	5
16 to < 21 years	0.00001	0.2	-	0.00002	0.3	-	5
Total Child	-	-	2E-4	-	-	6E-4	21
Adult	0.000006	0.1	3E-5	0.00002	0.2	2E-4	33

Source: [SulTRAC, 2016]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years
* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table 25: Residential Property (Current and Future Exposure) Child and Adult Resident: Combined ingestion and dermal exposure doses for chronic exposure to manganese in soil at 3,370 mg/kg*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
Birth to < 1 year	0.062†	-	-	0.1†	-	-	1
1 to < 2 years	0.061†	-	-	0.093†	-	-	1
2 to < 6 years	0.037	-	-	0.064†	-	-	4
6 to < 11 years	0.027	-	-	0.041	-	-	5
11 to < 16 years	0.018	-	-	0.022	-	-	5
16 to < 21 years	0.016	-	-	0.019	-	-	5
Total Child	-	-	-	-	-	-	21
Adult	0.0057	-	-	0.0087	-	-	33

Source: [SulTRAC, 2016]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram

chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years
* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0
† Indicates a dose greater than the known effect level of 0.06 mg/kg/day, which ATSDR evaluates further

Table 26: Residential Property – IEUBK Results – Future Children*

Child Age (years)	Lead EPC (mg/kg)	EPC Type	Projected Geometric Mean BLL (µg/dL)	Probability of Exceeding 5 µg/dL (%)
1 to <6 (12 to 72 months)	190	Arithmetic mean	2.2	4

Source: [SulTRAC, 2016]
Abbreviations: IEUBK = Integrated Exposure Uptake Biokinetic model; EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
* The calculations in this table were generated using EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model v2.0.

Table 27: Residential Property – All Ages Lead Model Results – All Residents*

Exposure Group	Baseline BLL (µg/dL)†	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Past Resident (1970 - 1993) (Child (6-21), Male)	15	512	Maximum detection	12	100	97†
Past Resident (1970 – 1993) (Child (6-21), Female)	15	512	Maximum detection	13	100	98†
Past Resident (1970 – 1993) (Adult, Male)	2.0	512	Maximum detection	2.7	28	9†
Past Resident (1970 - 1993) (Adult, Female)	1.4	512	Maximum detection	2	17	4
Current Resident (1993 – 2009) (Adult, Male)	2.0	512	Maximum detection	2.6	26	8‡
Current Resident (1993 – 2009) (Adult, Female)	1.4	512	Maximum detection	2	14	3
Current Resident (During Erosion Incident 2009-2011) (Adult, Male)	2.1	536	Arithmetic mean	2.5	27	9†
Current Resident (During Erosion Incident 2009-2011) (Adult, Female)	1.6	536	Arithmetic mean	2.2	17	4

Exposure Group	Baseline BLL (µg/dL)[†]	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Future Resident After 2011 (Child, Male)	0.48	190	Arithmetic mean	0.7	0.0	0.0
Future Resident After 2011 (Child, Female)	0.48	190	Arithmetic mean	0.7	0.0	0.0
Future Resident After 2011 (Adult, Male)	0.86	190	Arithmetic mean	1.1	1	0.1
Future Resident After 2011 (Adult, Female)	0.67	190	Arithmetic mean	1.2	0.4	0.0

Source: [IEPA, 2001; Weston Solutions, 2010; SulTRAC, 2016]
Abbreviations: EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
[*] The calculations in this table were generated using EPA's All Ages Lead Model v3.0.
[†] Source: EPA America's Children and the Environment Data Tables (1976-1980); NHANES Biomonitoring Data Tables for Environmental Chemicals, Blood Lead (1999 – 2010) and (2011 – 2018)
[‡] Indicates values which exceed 5%, which ATSDR considers a health hazard.

Table 28: Horseshoe Settling Pond and Overland Flow Route – All Ages Lead Model Results – Workers, Hunters, and Trespassers*

Exposure Group	Baseline BLL (µg/dL)	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Workers (Male)	1.3	1,676	Arithmetic mean	2.0	11	2
Workers (Female)	0.97	1,676	Arithmetic mean	1.8	8	2
Hunters/Trespassers (Child (11-21), Male)	1.5	1,676	Arithmetic mean	1.4	3	0.4
Hunters/Trespassers (Child (11-21), Female)	1.5	1,676	Arithmetic mean	1.7	7	1
Hunters/Trespassers (Adult, Male)	2.0	1,676	Arithmetic mean	2.5	24	7[†]
Hunters/Trespassers (Adult, Female)	1.4	1,676	Arithmetic mean	2	11	3

Source: [Weston Solutions, 2010; SulTRAC, 2016]
Abbreviations: EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
[*] The calculations in this table were generated using EPA's All Ages Lead Model v3.0. Property owner = Those who live own and hike on their wooded property; Hunter/Trespasser = Those who hunt in the exposure unit. Same exposure frequency is assumed for those who trespass; Site Worker = Those performing remedial work on the exposure unit.
[†] Source: NHANES Biomonitoring Data Tables for Environmental Chemicals, Blood Lead (1999 – 2010) and (2011 – 2018)
[‡] Indicates values which exceed 5%, which ATSDR considers a health hazard.

Table 29: Smallpox Creek – All Ages Lead Model Results – Anglers*

Exposure Group	Baseline BLL (µg/dL)†	Lead EPC (mg/kg)	EPC Type	Projected Average BLL (µg/dL)	Probability of Exceeding 3.5 µg/dL (%)	Probability of Exceeding 5 µg/dL (%)
Anglers (Male)	2.0	210	Arithmetic mean	2.1	14	3
Anglers (Female)	1.4	210	Arithmetic mean	1.5	3	1

Source: [SulTRAC, 2016]
Abbreviations: EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; BLL = blood lead level; µg/dL = microgram chemical per deciliter blood
* The calculations in this table were generated using EPA's All Ages Lead Model v3.0.
† Source: NHANES Biomonitoring Data Tables for Environmental Chemicals, Blood Lead (1999 – 2010) and (2011 – 2018)

Table 30: Cancer Risks ≥ 1E-06 in Descending Order from Soil Ingestion, Dermal Contact

Exposure Unit	Exposure Type	Exposure Group	EPC (mg/kg)	EPC Type	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
Residential Property (After 2011)	Soil/Dust Ingestion and Dermal Contact	Resident, Future Child (Birth-21)	16	Maximum	32	6E-4
Tailings Pile	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Adult	120	95UCL of the mean	32	3E-4
Residential Property (After 2011)	Soil/Dust Ingestion and Dermal Contact	Future Adult Resident	16	Maximum	32	2E-4
Tailings Pile	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Child (11-21)	120	95UCL of the mean	32	2E-4
Surrounding Wooded Properties	Soil Ingestion and Dermal Contact	Property Owner, Adult	30	95UCL of the mean	32	1E-4
Residential Property (2000-2009)	Soil/ Dust Ingestion and Dermal	Adult Resident	32	95UCL of the mean	32	1E-4

Exposure Unit	Exposure Type	Exposure Group	EPC (mg/kg)	EPC Type	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
	Contact					
Surrounding Wooded Properties	Soil Ingestion and Dermal Contact	Property Owner, Child (11-21)	30	95UCL of the mean	32	8E-5
Horseshoe Settling Pond and Overland Flow Route	Soil Ingestion and Dermal Contact	Workers	30	95UCL of the mean	32	8E-5
Horseshoe Settling Pond and Overland Flow Route	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Child (11-21)	30	95UCL of the mean	32	4E-5
Surrounding Wooded Properties	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Adult	30	95UCL of the mean	32	3E-5
Horseshoe Settling Pond and Overland Flow Route	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Adult	30	95UCL of the mean	32	3E-5
Residential Property (During Erosion Incident)	Soil/Dust Ingestion and Dermal Contact	Adult Resident	30	95UCL of the mean	32	3E-5
Surrounding Wooded Properties	Soil Ingestion and Dermal Contact	Hunter/Trespasser, Child (11-21)	30	95UCL of the mean	32	2E-5
Tailings Pile	Soil Ingestion and Dermal Contact	Workers	120	95UCL of the mean	32	2E-5
Smallpox Creek	Sediment Ingestion and Dermal Contact	Angler, Adult	8	95UCL of the mean	32	2E-5

Exposure Unit	Exposure Type	Exposure Group	EPC (mg/kg)	EPC Type	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
Surrounding Wooded Properties	Soil/Dust Ingestion and Dermal Contact	Workers	30	95UCL of the mean	32	6E-6

Source: [Weston Solutions, 2010; SulTRAC, 2016]
Abbreviations: ≥ 1E-06 = greater than or equal to 1 in 1,000,000; EPC = exposure point concentration; $(mg/kg/day)^{-1}$ = change in cancer risk per milligram chemical per kilogram body weight per day

Noncancer doses were calculated as follows:

$$D_{oral,\ noncancer} = \frac{C \times IR \times EF \times CF}{BW}$$

Example: noncancer arsenic dose calculation using the tailings pile hunter/trespasser scenario:

$$D_{oral,\ noncancer} = \frac{120 \times 100 \times\ 0.21 \times 10^{-6}}{80.6}$$

$$D_{oral,\ noncancer} = 2.3\text{E-05 mg/kg/day}$$

Example: noncancer hazard quotient due to arsenic exposure using the tailings pile hunter/trespasser scenario (HQ = site dose/health guideline):

HQ = 2.3E-05 mg/kg/day ÷ 3.0E-04 mg/kg/day

HQ = 0.078

Cancer risks (CR) were calculated as follows:

$$CR = D_{oral,\ noncancer} \times CSF \times (ED \div LY)$$

Example: cancer risk due to arsenic exposure using site worker scenario:
Risk = 2.3E-05 mg/kg/day x 1.5E+00 $(mg/kg/day)^{-1}$ × (33 ÷ 78)

Risk = 1.5E-5

$D_{oral,\ noncancer}$ = Exposure dose by oral exposure route (mg/kg/day)
C = Concentration of contaminant
IR = Intake rate, amount of soil and dust a person ingests each day in mg
EF = Exposure factor, proportion of days someone is exposed to contaminated media in a year
CF = Conversation factor used in soil exposure dose calculations
BW = Body weight in kg

HQ = Hazard quotient, result of dividing exposure dose by health guideline
CR = Cancer risk, theoretical chance for getting cancer if exposed to a contaminant. Expressed in scientific notation. E.g. 1.5E-5 = 1.5 extra cases in 100,000 people
CSF = Cancer slope factor, contaminant-specific number applied to an exposure dose to derive cancer risk
ED = Exposure duration, how many years the exposure lasts
LY = Lifetime in years

Appendix E: Glossary of Terms

The glossary in this appendix defines the various terms that were used in this Public Health Assessment. This glossary defines words used by ATSDR and IDPH in communications with the public. It is not a complete dictionary of environmental health terms. For additional questions or comments, call 1-800-CDC-INFO.

95UCL

95 percent upper confidence limit of the arithmetic mean. Health assessors use statistical tools such as EPA's ProUCL and R to calculate the 95UCL for the exposure point concentration (EPC).

Absorption

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

Acute (duration of exposure)

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

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems.

Agency for Toxic Substances and Disease Registry (ATSDR)

A federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases from toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces laws to protect the environment and human health.

Analyte

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

Bioavailability factor

The amount of a contaminant that is absorbed into a person's body. It is the percent of the total amount of a contaminant ingested, inhaled, or dermally contacted that enters the bloodstream and is available to potentially harm a person. When performing exposure dose calculations during the PHA process, ATSDR assumes this factor to be 1 (i.e., all of a contaminant to which a person is exposed is assumed to be absorbed) for all exposure pathways and contaminants, with one exception: arsenic via soil ingestion. Health assessors should not adjust the bioavailability factor of 1 for any contaminant other than arsenic without first consulting with a toxicologist and getting the approval of the Associate Director for Science group.

Cancer

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

Cancer risk (CR)

A theoretical chance for getting cancer if exposed to a contaminant. Cancer risk is calculated for carcinogens with available cancer risk values (oral cancer slope factors [CSFs], inhalation unit risks [IURs]). Cancer risk is obtained by multiplying an oral CSF by an estimated exposure dose and by multiplying an IUR by an air concentration.

Cancer Risk Evaluation Guides (CREGs)

ATSDR's CREGs are concentrations of a carcinogen in a media (water, soil, or air) at which excess cancer risk is not likely to exceed one case of cancer in one million people (1.0E-06) exposed over a lifetime (78 years). CREGs are calculated from EPA's cancer slope factors (CSFs) for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure.

Carcinogen

A substance that causes cancer.

Central nervous system

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

Central tendency exposure (CTE)

Refers to individuals who have average or typical exposure to a contaminant. For instance, at an example site where children < 21 years old are exposed to a chemical via incidental surface water ingestion, the estimated CTE lifetime cancer risk is 1.6E-06 – based on the average swimming ingestion intake rate of 0.049 liter per hour (L/hour) and exposure duration of 12 years. This can be compared to a reasonable maximum exposure (RME) lifetime cancer risk for the same population of 5.4E-05, which is based on the 95th percentile swimming ingestion intake rate of 0.12 L/hour and exposure duration of 33 years.

Chronic

Occurring over a long time [compare with acute].

Chronic exposure

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

Community

People who may be directly affected by site contamination because they currently live near the site or have lived near the site in the past. Community members may include, for example, residents, members of local action groups, local officials, tribal members, health professionals, and local media. The community is at the heart of all public health process activities.

Comparison value (CV)

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

Completed exposure pathway

All five elements of a pathway are present: contaminant source, environmental fate and transport, exposure point, exposure route, and potentially exposed population. A completed exposure pathway exists when there is direct evidence or, in the judgment of the health assessor, a strong likelihood that people have in the past, are presently, or could in the future come into contact with site-related contaminants.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

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

Concentration

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

Contaminant

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

Chronic (duration of exposure)

Contact with a substance that occurs over a long time (365 or more days) [compare with acute exposure and intermediate exposure].

Dermal

Referring to the skin. For example, dermal contact means passing through the skin.

Dermal contact

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

Detection limit

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

Discrete sample

An individual environmental sample from a given point and time that is independent of other samples.

Dose

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Effect

Any change in physiologic function or cellular structure as a result of an exposure to an environmental contaminant.

Eliminated exposure pathway

At least one of the five elements of a pathway is not present and either will never be present or is extremely unlikely to ever be present: contaminant source, environmental fate and transport, exposure point, exposure route, and potentially exposed population. Health assessors classify an exposure pathway as eliminated after determining that exposure has not occurred in the past, is not occurring currently, and is extremely unlikely to occur in the future.

Environmental media

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

Environmental Media Evaluation Guides (EMEGs)

EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation. EMEGs are calculated from ATSDR minimal risk levels (MRLs) for chronic or intermediate exposures (those occurring longer than 365 days or from between 14-365 days, respectively), as well as acute time frames (14 days of exposure or less). There are specific EMEGs for adults and children. Not all contaminants have chronic, intermediate, or acute EMEGs.

EPA (U.S. Environmental Protection Agency)

The primary federal agency responsible for environmental issues, including research, monitoring, enforcement, and cleanup functions. ATSDR (using its public health assessment process) and EPA (using its risk assessment process) evaluate spills or releases of hazardous substances in the environment at Superfund sites to protect public health.

EPA Regional Screening Levels (RSLs)

RSLs are contaminant concentrations in soil, water, or air, below which any harmful health effects would be unlikely. There are different RSLs depending on the setting in which the sampling data were collected. These are Residential and Commercial/Industrial. Further reading on the application of RSLs can be found here: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

Epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Exposure

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

Exposure pathway

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

Exposure point concentration (EPC)

A representative contaminant concentration. When appropriate, ATSDR calculates an EPC for each exposure unit or area, individual completed and potential exposure pathway, and exposure duration: acute (0-14 days), intermediate (15-364 days), or chronic (365 or more days) durations.

Exposure unit

A geographically defined point or area where a person is expected to contact an environmental medium, such as soil, surface water, groundwater, air, or food items (e.g., fruits, vegetables, fish, game). Health assessors define exposure units for each potential contaminant of concern identified in a completed exposure pathway or potential exposure pathway.

Groundwater

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

Hazard

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

Hazard quotient (HQ)

A calculation to evaluate the potential for noncancer health hazards to occur from exposure to a contaminant with available noncancer health guidelines (MRLs, RfDs, RfCs). Typically, the hazard quotient is obtained by dividing the duration-specific (acute, intermediate, or chronic) exposure dose or concentration by the noncancer health guideline for the same duration for your exposure groups of interest.

Hazardous substance

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

Health guidelines

Values that serve as the basis for ATSDR's noncancer comparison values. They consist of oral human doses and air concentrations developed from toxicology or epidemiology studies (with safety factors applied) that are protective of human health.

Health outcome data

Information from private and public institutions on the health status of populations. Health outcome data can include morbidity and mortality statistics, birth statistics, tumor and disease registries, or public health surveillance data.

Ingestion

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

Intermediate (duration of exposure)

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

Limitation

Missing, unknown, or assumed information, as part of the public health assessment process, that can be critical to make a public health call, help you understand what contaminants, and at what concentrations, people could be exposed to, and lend uncertainty to the public health conclusions.

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. For example, mice exposed to an air concentration of 250 parts per million (ppm) experienced shallow breathing, and the study reported 250 ppm as a LOAEL.

Maximum Contaminant Levels (MCLs)

MCLs are derived by EPA as enforceable standards for municipal water systems. These standards are not strictly health-based but are set as close to the maximum contaminant level goals (MCLGs) (Health Goals) as is feasible and are based upon treatment technologies, costs (affordability) and other feasibility factors, such as the availability of analytical methods, treatment technology, and costs for achieving various levels of removal.

Metabolism

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

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects.

MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs are not used as predictors of harmful (adverse) health effects [see reference dose].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

Point of exposure

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

Population

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

Potentially exposed population

The fifth part of an exposure pathway. This represents the people who potentially have, do, or could come in contact with environmental contaminants.

Potential contaminant of concern

A label given to a contaminant if its concentration meets or exceed screening levels, or its estimated exposure dose or cancer risk levels exceed acceptable levels. It is important to note that chemicals flagged as potential contaminants of concern do not necessarily pose a health threat. Further evaluation is needed to evaluate contaminants flagged as potential contaminants of concern. For example, trichloroethylene detected in air above the ATSDR comparison value would represent a potential contaminant of concern and require further evaluation.

Prevention

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

Public health assessment (PHA)

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

Public health surveillance

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

Reference dose (RfD)

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

Remedial investigation (RI)

The CERCLA process of determining the type and extent of hazardous material contamination at a site. EPA is responsible for conducting RIs at Superfund sites.

Risk

The probability that something will cause injury or harm.

Route of exposure

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

Reasonable maximum exposure (RME)

Refers to people who are at the high end of the exposure distribution (approximately the 95th percentile), a scenario intended to assess exposures that are higher than average, but still within a realistic exposure range. For instance, at an example site where children < 21 years old are exposed to a chemical via incidental surface water ingestion, the estimated RME lifetime cancer risk is 5.4E-05, which is based on the 95th percentile swimming ingestion intake rate of 0.12 liter per hour (L/hour) and exposure duration of 33 years. This can be compared to the central tendency exposure (CTE) lifetime cancer risk for this population of 1.6E-06 – based on the average swimming ingestion intake rate of 0.049 L/hour and exposure duration of 12 years.

Sample

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

Sample size

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

Site assessment (SA)

A Pre-CERCLA process of investigating the type of hazardous material contamination at a site which aids in determining if a site is added to the National Priorities List (see **National Priorities List for Uncontrolled Hazardous Waste Sites**). EPA is responsible for conducting SA's.

soilSHOP

Soil Screening, Health, Outreach, and Partnership (soilSHOP) events bring same day, soil screening to community members. At soilSHOP, participants bring soil gathered from their gardens or outdoor play area(s) and screen it for contaminants, including lead. Through soilSHOPs, ATSDR and partner organizations inform community members about lead soil contamination and share tips for reducing potential exposure.

Source of contamination

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

Substance

A chemical.

Superfund Amendments and Reauthorization Act (SARA)

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

Surface soil

Defined by ATSDR as the top 3 inches of soil. Health assessors can use soil sampling results collected from deeper than 3 inches (e.g., EPA commonly collects samples at a depth of 0-6 inches) to evaluate exposures, as long as it is documented.

Surface water

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

Toxicological profile

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

Toxicology

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

Transport mechanism

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

Appendix F: Contaminants of Concern and Health Guidelines Used

Appendix E describes in general the health problems associated with each of the potential COCs related to the Site. Information is provided about the health guideline that was used in the development of Hazard Quotients (HQs). Additional information about each potential COC can be found in ATSDR's Toxicological Profiles.

Arsenic
Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. Elemental arsenic (sometimes referred to as metallic arsenic) is a steel grey solid material. Arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Combined with these elements it is called inorganic arsenic (ATSDR, 2007).

Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead. Arsenic is also used in wood preservation and has historically been used in pesticides (though using inorganic arsenic is now banned for this purpose). The natural concentration of arsenic in soil varies widely, generally ranging from about 1 to 40 milligrams per kilogram (mg/kg) with an average level of 5-7 mg/kg. However, soils in the vicinity of arsenic rich geological deposits, some mining and smelting sites, or agricultural areas where arsenical pesticides had been applied in the past may contain much higher levels of arsenic (ATSDR, 2007).

Inorganic arsenic has been recognized as a human poison since ancient times, and very high doses can result in death. Ingestion of large amounts of arsenic in water can cause irritation of the stomach and intestines, with symptoms such as abdominal pain, nausea, vomiting, and diarrhea. Other adverse effects include decreased production of red and white blood cells, which may cause fatigue, abnormal heart rhythm, blood vessel damage resulting in bruising, and impaired nerve function causing a "pins and needles" sensation in the hands and feet (ATSDR, 2007).

Perhaps the single-most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. These include patches of darkened skin and the appearance of small "corns" or "warts" on the palms, soles, and torso, and are often associated with changes in the blood vessels of the skin. Skin cancer may also develop. Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, and lungs. The National Toxicology Program (NTP) has determined that inorganic arsenic is known to be a human carcinogen (a chemical that causes cancer). The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans. EPA also has classified inorganic arsenic as a known human carcinogen (ATSDR, 2007).

There is no intermediate MRL for arsenic. The chronic MRL for arsenic (0.0003 mg/kg/day) is based on studies of skin lesions and skin cancer in people in areas of Taiwan that had high concentrations of arsenic in the drinking water (ATSDR, 2007). EPA released an updated RfD of 0.00006 mg/kg/day for arsenic in January of 2025. This RfD was updated based on strong associations between arsenic exposure and increased incidences of diabetes and ischemic heart disease in humans. However, at doses calculated for the Site, people are not at risk for experiencing noncancer health problems like those listed here.

The cancer slope factor for arsenic is 32 $(mg/kg/day)^{-1}$. The maximum calculated lifetime excess cancer risk for arsenic was 2 in ten thousand (2.0E-04) people for the future adult and child residents at the residential property. Exposures to arsenic in residential soils present an increased chance of bladder or lung cancer in future residents.

Cadmium

Cadmium is a soft, silver-white metal that occurs naturally in the Earth's crust. Cadmium is not usually present in the environment as a pure metal, but as a mineral combined with other elements. Cadmium occurs in the Earth's crust at a concentration of 0.1-0.5 mg/kg and is commonly associated with zinc, lead, and copper ores. Cadmium has many industrial uses and is used in consumer products including batteries, pigments, metal coatings, plastics, and some metal alloys. In the United States, the largest source of cadmium exposure for nonsmoking adults and children is through dietary intake (ATSDR, 2012).

The main targets of cadmium toxicity are the kidney and bone following oral exposure and kidney and lung following inhalation exposure. Other effects that have been observed in humans and/or animals include reproductive toxicity, hepatic effects, hematological effects, and immunological effects. Cadmium is classified as a known human carcinogen by the NTP and was shown to cause tumors when administered to experimental animals by inhalation, orally, or by injection. However, exposure to cadmium concentrations at the Site are not likely to cause harmful health effects, as previously stated in this document.

EPA has not developed an oral cancer slope factor for cadmium. Therefore, no quantitative assessment of the likelihood for increased risk of cancer from the estimated oral exposure to cadmium at the Site was made (ATSDR, 2012).

The intermediate MRL for cadmium (0.0005 mg/kg/day) is based on studies of disorders in bone metabolism of female rats exposed to cadmium. The chronic MRL for cadmium (0.0001 mg/kg/day) is based on studies of kidney effects in people (ATSDR, 2012).

Lead

Lead is a heavy, low melting, bluish-gray metal that occurs naturally in the Earth's crust. However, it is rarely found naturally as a metal. It is usually found combined with two or more other elements to form inorganic lead compounds. It is used in some types of batteries, ammunition, ceramic glazes, medical equipment, scientific equipment, and military equipment. At one time, lead was used as an additive in gasoline and paint (ATSDR, 2020). Paint containing lead is still present in older homes and becomes more available for uptake into the body if it is deteriorated or flaking. Lead mine tailings are contaminated with lead and can be an additional source of lead to people living nearby.

Lead bioaccumulates in the body, primarily in the skeleton, and body burdens vary significantly with age, health status, and nutritional state. Although lead in bone is a biomarker of cumulative exposure, lead is evaluated based on blood lead concentrations.

Lead affects virtually every organ and system in the body if exposures are high enough and for long enough periods and exhibits a broad range of health effects. The most sensitive of these are the central nervous system, hematological, and cardiovascular systems, and the kidney. However, it is particularly harmful to the developing brain and nervous system of fetuses and young children (ATSDR, 2020).

Some research has shown that low BLLs can cause cognitive and neurobehavioral effects in older adults (ATSDR, 2020). There is also research that has shown an association between BLLs and increased blood pressure as well as increased risk of heart disease, arterial plaque build-up, altered heartbeat, and increased chances of death from cardiovascular disease (ATSDR, 2020). In general, it appears that there is a growing body of research that is suggesting BLLs less than 10 µg/dL may cause adverse health effects in adults.

No safe level of lead in the blood has been identified. However, the Centers for Disease Control and Prevention has established a blood lead reference value (BLRV). The reference value is not meant as a predictor of harmful effects, but rather as a protective guideline to help determine whether medical or environmental follow-up are recommended and to guide efforts in reducing lead exposures in communities (CDC, 2024). In 2021, the Lead Exposure and Prevention Advisory Committee updated the BLRV from 5 µg/dL to 3.5 µg/dL, citing data from the 2015-2016 and 2017-2018 National Health and Nutrition Examination Survey cycles (CDC, 2024).

In the absence of blood lead data, IDPH assessed health risks from the exposure to lead using predictive modeling. EPA uses two predictive lead models for risk assessment purposes: the Integrated Exposure Uptake Biokinetic (IEUBK) model for children aged 6 months to 7 years (EPA, 2021), and the All Ages Lead Model (AALM) (EPA, 2024). IDPH used the IEUBK model to assess exposure for children aged six months to 7 years who lived or will live at the West Area residence on Blackjack Road, across from the tailings pile. Because pre-teens and teenagers are more likely to explore the site and use it for recreation than younger children, IDPH used the AALM to assess health impacts for adults and children ages 11-21 for much of the Site, but also used the AALM for children beginning at the age of 8 years into adulthood at the residential property. The AALM expands upon the IEUBK model to include older childhood and adult lead exposure. It allows assessment for intermittent exposures of one day or more, as well as chronic exposures. The AALM can be applied to specific individuals or to groups of similarly exposed individuals.

IDPH used the AALM model to predict the BLL in children over the age of 7 at the residential property as well as adults throughout the rest of the Site. IDPH used the former BLRV of 5 µg/dL for this assessment, as opposed to the recently updated BLRV of 3.5 µg/dL. This is because the current ATSDR methodology for lead risk assessment is to model the probability that lead exposure will result in exceedance of a target BLL of 5 µg/dL. ATSDR uses a target blood level of 3.5 µg/dL when multiple sources of lead have been identified in lead-exposed populations.

ATSDR considers a greater than 5% probability of exceeding the BLRV of 5 µg/dL to be an increased risk of possible harmful health effects. AALM modeling estimated greater than a 5% chance of exceeding the BLRV throughout the Site. Some impacted areas on the Site have been remediated, so future exposures have been eliminated, but past exposure to lead in mine tailings throughout the Site posed a long-term public health hazard. The tailings pile and surrounding wooded properties have not been remediated and are readily accessible. Therefore, lead in mine tailings at the tailings pile and surrounding wooded properties are a long-term public health hazard for current and future exposures.

Lead is classified by NTP as reasonably anticipated to be a human carcinogen based on evidence in animal studies that lead exposure was associated with tumors, mainly of the kidney, but also brain, blood system, and lung. However, EPA has not developed an oral cancer slope factor for lead. Therefore, no quantitative assessment of the likelihood for increased risk of cancer from the estimated oral exposure to lead at the Site was made.

Manganese

Manganese is a naturally occurring element and an essential nutrient. Manganese does not exist in nature as an elemental form, but is found mainly as oxides, carbonates, and silicates in over 100 minerals with pyrolusite (manganese dioxide) as the most common naturally occurring form. Manganese is required for the formation of healthy cartilage and bone in the urea cycle, aids in the maintenance of mitochondria, and the production of glucose (ATSDR, 2012b). It is also used extensively in industry, being used as an additive during steel production and a wide range of other products such as dry-cell batteries, paints, and cosmetics (ATSDR, 2012b).

Manganese is an essential nutrient so having a certain amount in your diet is necessary to remain healthy. However, very high oral doses of manganese have shown evidence of nervous system disturbances, reproductive issues, and kidney/urinary tract issues in animals (ATSDR, 2012b). Extremely high levels of manganese exposure may produce undesirable effects on brain development, including behavioral and learning changes in developing children and infants (ATSDR, 2012b).

ATSDR has not developed a chronic, oral MRL for manganese. However, there are multiple human studies which observed deleterious effects on learning in young children at doses of 0.06 to 0.08 mg/kg/day within 5-10 years of exposure (ATSDR, 2012b). Based on one sample taken from the edge of the residential property near the Site, future children less than 2 years of age could ingest and absorb 0.077 mg/kg/day from combined oral and dermal exposure. However, there is some uncertainty in applying the current LOAEL to soil exposure scenarios, as this LOAEL was derived from a drinking water study and the bioavailability of manganese in soil is not well understood.

Zinc

Zinc is a common element found in the air, soil, water, and all foods. It is mined for use in various industries, including iron coating, brass and bronze, pennies, and dry cell batteries. Different types of food contain different levels of zinc. Zinc is an essential element needed by the body in small amounts (ATSDR, 2005). A lack of zinc, as well as an excess of zinc, can be harmful to human health.

The levels of zinc that must be consumed to cause adverse health effects are 10 to 15 times higher than the Recommended Daily Allowance (RDA) for zinc. For men the RDA is 11 mg/day and for women, it is 8 mg/day (ATSDR, 2005). If extremely high levels are taken by mouth for a short time, stomach cramps, nausea, and vomiting may occur. If large doses are ingested for several months anemia, damage to the pancreas, and decreased levels of high-density lipoprotein (HDL) cholesterol may occur (ATSDR, 2005).

The intermediate and chronic MRLs for zinc (0.3 mg/kg/day) are based on studies of zinc supplements in adult females (ATSDR, 2005). At doses calculated for the Site, people are not at risk for experiencing noncancer health problems like those listed here.