Health Consultation

VALLES MINES

VALLES MINES SCHOOL ROAD

JEFFERSON COUNTY, MISSOURI

EPA FACILITY ID: MON00070446

OCTOBER 4, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

VALLES MINES

VALLES MINES SCHOOL ROAD

JEFFERSON COUNTY, MISSOURI

EPA FACILITY ID: MON00070446

Prepared by:

Missouri Department of Health and Senior Services
Division of Environmental Health and Communicable Disease Prevention
Section for Environmental Public Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

TABLE OF CONTENTS

STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

The Missouri Department of Natural Resources (MDNR) has requested that the Missouri Department of Health and Senior Services (DHSS), in conjunction with the federal Agency for Toxic Substances and Disease Registry (ATSDR), complete a health consultation for the Valles Mines Site near Valles Mines, Jefferson County, Missouri. This health consultation examines contaminant concentrations, the potential for human exposure, and the corresponding threat to public health.

Background

The Valles Mines Company, founded in 1749, owns approximately 4,500 acres that were mined for lead in Jefferson and St. Francois counties (1). The Valles Mines site is a portion of their property (approximately 500 acres) located near the town of Valles Mines, in Jefferson County, Missouri, just southwest of the intersection of State Highway V and Highway 67, on Valles Mines School Road (Figures 1 and 2). The Valles Mines Company operated lead strip mines at this site from approximately 1824 through the 1930's. Early on, the company operated three Scotch hearth furnaces at the site for smelting lead. These furnaces were later replaced with a new smelter. Lead ore from other mines was brought to the Valles Mines site for smelting.

The Valles Mines Site is a privately owned historic site, used for recreational purposes. Existing historic structures on-site include the old general store, a log cabin, and mill building remains (1). Figure 3 is a map of the site. Employees currently use the general store as the on-site headquarters. Immediately adjacent to the general store is the log cabin once inhabited by Francois Valles, the Valles Mines Company founder. The log cabin is now the location of the Lost History Museum frequented by visitors to the site. The museum houses artifacts and historical information from the company, the town, and the surrounding areas. It also contains information about the lead mining operations at the site and historical lead mining in Jefferson and St. Francois counties. In addition to touring the Lost History museum, visitors can hike, ride horses, fish, hunt, and observe wildlife at the site. Most of the visitors to the site either tour the museum or lease land for hunting.

Including historic structures, the Valles Mines site contains several houses, two streams (Finney Creek and Valles Mines Creek), an old abandoned railroad, a spring, and remnants of an old smelter chimney. There is also a lake on-site located approximately 3 ½ miles west of the smelter chimney. The former railroad spur was used to ship lead and zinc to other markets. The railroad spur is located to the south of Highway V, to the west of Valles Mines Creek. A large drainage ditch is present about 100 feet south of Highway V, which cuts through the former railroad spur area (1). The only restriction for access to any part of the site is a single rope that fences the area immediately around the old smelter chimney (1). Access to the soil in this area and the rest of the site is unrestricted.

There is an artesian well located less than 200 feet to the south of the old smelter chimney (1). Reportedly, this well was accidentally drilled in 1914 while searching for ore. Artesian wells flow spontaneously (like a fountain) from internal pressure. The well has never been dry in its existence (1). Area residents and visitors are consistently seen filling jugs with water for drinking from the well. Company personnel estimate that five to ten people collect water from the well per week. The Valles Mines Company routinely tests the well for cadmium, lead, and zinc. There has not been any detection of significant concentrations of any contaminants.

A mine waste or "chat" pile is located on the site at the confluence of Finney Creek and Valles Mines Creek, just to the west of Valles Mines School Road (1). The waste piles are commonly referred to as tailings and/or chat piles. Chat is defined as crushed ore material that is 3/8 inch or less in diameter and was primarily milled with the density separation process. The waste piles contain concentrations of heavy metals associated with lead and zinc mining operations. The chat pile is approximately 1-acre in size and ranges from two to 15 feet in depth. Along the eastern side of the pile, there is evidence of illegal dumping. Various pieces of debris, appliances, a burned motorcycle, and dead animals have been observed at the base of the pile (1). According the Valles Mines Company personnel, the company periodically hauls the dumped items to a landfill. Efforts to end the illegal dumping have not been successful.

Separate from the Valles Mines site, parts of the Valles Mines property are used for a tree farm, reclamation project, and a wildlife refuge. The tree farm and reclamation project has regenerated the oak-hickory forest on the property; select areas are in their 16th year of re-establishing three separate species of pines (1). In coordination with the Wildlife Rehabilitation Clinic in Fenton, Missouri, several species of animals have been released onto the Valles Mines site. The animals released there include populations of red foxes, raccoons, ground hogs, and opossums (1).

Site Investigations

In August of 2002, the Missouri Department of Natural Resources (MDNR) conducted environmental sampling as part of a pre-Comprehensive Environmental Response, Compensation Information System (CERCLIS) site screening at the Valles Mines site. The purpose of this investigation was to determine if the site was eligible for entry into CERCLIS, which is the US Environmental Protection Agency's (EPA) inventory of potentially hazardous substance sites. A CERCLIS site is a site that may present a danger to human health or the environment due to a release of hazardous substances into the environment, or a substantial threat of release.

During the pre-CERCLIS site screening, MDNR collected soil, groundwater, surface water, and sediment samples. In addition, in-situ soils were screened with a portable X-ray fluorescence spectrometer (XRF) unit. Surface water samples were collected from the Valles Mines Creek, within the drainage area of the chat pile and also further downstream. A groundwater sample was collected from the on-site artesian well.

The contaminants of concern from this sampling event were cadmium, lead, and zinc, with lead being of the most concern. See Tables 1 through 4 for a listing of selected results from this

sampling event. The lead levels found in the old smelter area ranged from 41,600 to 50,800 parts per million (ppm) and 14,300 ppm in the old railroad spur area. The soil samples collected from the chat pile, near the former mill building, contained lead concentrations ranging from 1,800 to 44,200 ppm. Cadmium levels in these areas ranged from 4.8 ppm to 130 ppm. Zinc was found in levels ranging from 1040 ppm to 60,200 ppm.

In MDNR's report summarizing this site screening, further remedial action was recommended based on the levels of contamination found in the on-site surface soil. The site was entered onto CERCLIS for further action.

On May 27, 2004, a Preliminary Assessment/Site Inspection/Removal Assessment (PA/SI/RA) was conducted at the Valles Mines site. Surface soil, sediment, surface water, and groundwater samples were collected from three sampling areas of concern. The first sampling area was the soil surrounding the old smelter chimney. The second area was Valles Mines, Joachim Creek, the chat piles, and the old railroad spur. Surface water and sediment samples were collected from the creeks. Surface soil samples were collected from the chat piles and old railroad spur. The final sampling area was residential yards and gardens within the town of Valles Mines whose owners allowed access to their property (Table 5). The six residential yards that were sampled are located less than one-half mile from the site. All soil and sediment samples were analyzed by XRF, with a portion sent for confirmatory laboratory analysis. During laboratory analysis and when appropriate, some samples were tested to determine the potential for metals to leach into groundwater. Surface water samples were analyzed for the dissolved constituents of lead, cadmium, and zinc as well as total lead, cadmium, and zinc (1).

Some of the residential yards, as well as, gardens in the town of Valles Mines had lead levels of concern. The levels ranged from 84 to 1,320 ppm (Table 5). Some yards had levels of zinc that were more than three times the background levels; however, these levels were still below health comparison values.

On-site, the yard soils of the museum and visitors center had lead levels ranging from 1,850 to 2,890 ppm. See Table 5 for a listing of selected soil sampling results from the PA/SI/RA. Table 6 is a listing of selected analytical results for the sediment samples.

The surface soil samples (0 to 6 inches in depth) were collected along transects that radiated away from the old smelter, from the yards of the museum and visitor's center building, and from the mill waste pile, near the former mill. MDNR also set up transects perpendicular to the old railroad spur at two locations and collected surface soil samples of the rail bed material at varying distances from the centerline. Lead levels found in the soils near the railroad spur transect ranged from 30 ppm to over 19,000 ppm. See Table 7 for a listing of the soil sample results. Lead levels ranged from 143 ppm to 4,790 ppm in the sediment samples.

DISCUSSION

The soil samples taken from the Valles Mines site in the area near the old smelter, visitors (recreation) center, chat pile, and railroad transect contained elevated levels of lead, cadmium, and zinc. The soil samples collected from the chat pile, near the former mill building, contained lead concentrations ranging from 1,800 to 44,200 ppm. These levels were more than three times greater than local background levels. The levels are also greater than levels considered to be a health concern. Typically, lead levels above 400 ppm in soil where human contact can occur are considered to be a health concern.

Cadmium levels in these areas ranged from 4.8 ppm to 130 ppm. According to ATSDR, an acceptable level of cadmium in the soil would be 10 ppm for child exposure and 100 ppm for adults in a residential setting. It is difficult to compare recreational areas to residential settings; however, the acceptable residential levels may give an indication of health risk.

Zinc was found at the site in levels ranging from 1040 ppm to 60,200 ppm. Again, in residential settings, acceptable zinc levels are 20,000 ppm for children and 200,000 for adults.

MDNR collected surface water samples from the Valles Mines and Joachim Creek and compared the sampling results to EPA's Maximum Contaminant Levels (MCL) or EPA action levels (Table 8). An MCL is the maximum concentration of a contaminant allowed by the EPA in public drinking water. The federal action level for lead in drinking water is 15 micrograms per liter (µg/L). Since this water is not used as a drinking water source, results were also compared to MDNR's ambient water quality criteria/ ambient aquatic life advisory concentrations (AWQC/AALAC) and Missouri Water Quality Standards (MO WQS). The MO WQS are benchmarks for drinking water, groundwater, and protection of aquatic life, fish consumption, and irrigation/livestock watering use categories. Samples collected from both streams had levels of lead above 15 µg/L; however, there is no evidence that anyone is drinking this water. Surface water samples were collected from the two on-site creeks. However, samples were not collected from the on-site lake in which visitors fish and perhaps, consume fish that are caught.

The sediment sample taken from Valles Mines Creek during the first sampling event also had levels of arsenic, cadmium, lead and zinc above screening values. To better characterize the contamination, more sediment and surface water samples were collected during the second sampling event. The sediments samples taken from Valles Mines and Joachim Creek were found to contain elevated levels of arsenic, cadmium, and lead. Surface water samples taken from Valles Mines Creek and Joachim Creek during the second sampling event contained elevated lead levels. Therefore, ingestion of this water from the streams is not recommended. Although the on-site surface water is contaminated, the groundwater samples collected from the on-site artesian well did not contain elevated levels of lead, cadmium, or zinc. The Valles Mines Company also tests this well regularly. Drinking water from this well does not appear to present a health hazard.

Most visitors to the Valles Mines Site (approximately 200 to 300 per year) tour the museum located in the visitors center. It is unknown how many visitors also hike around the artesian well

and smelter area. The site is also advertised as a camping area; however, due to the lack of amenities it is rarely used for camping. A small amount of horseback riding and mountain biking also occurs on-site during the summer months. Individual hunters and groups of hunters lease parcels of land for deer hunting in the fall and winter.

It is difficult to know the amount of exposure that is occurring at this site. The potential for exposure does exist. Visitors to the site can readily access the areas that have elevated contaminant levels. Since the contaminants are present and accessible in parts of the site that are frequently visited, the amount of exposure determines if adverse health effects would occur. It is anticipated that the contamination at this site is only a problem for very frequent visitors.

Of most concern from these sampling events are the residential yards and gardens with the town of Valles Mines. The lead levels found at three of the residences exceed levels that are typically considered to be acceptable at residential properties. It is possible that if children live in those residences, the children are being exposed to the elevated lead levels.

TOXICOLOGICAL EVALUATION

This section will discuss the potential adverse health effects of exposure to arsenic, cadmium, lead, and zinc. Non-cancerous health effects and the likelihood of the contaminants causing cancer will be evaluated.

Arsenic

Exposure to arsenic can occur by eating food, drinking water, or breathing air that is contaminated with arsenic. Children may be exposed to arsenic because of hand-to-mouth contact or eating contaminated dirt. Skin contact with soil or water containing arsenic is also a valid exposure pathway. However, only a small amount will go through the skin to the body, so the dermal pathway is usually not a concern.

Long-term oral exposure to inorganic arsenic causes a pattern of skin changes. These include a darkening of the skin and the appearance of small “corns” or “warts” on the palms, soles, and torso. A small number of corns may ultimately develop into skin cancer (3). Ingesting arsenic has also been noted to increase the risk of cancer in the liver, bladder, kidney, prostate, and lungs. The federal Department of Health and Human Services, International Agency for Research on Cancer, EPA, and National Toxicology Program consider inorganic arsenic to be a known carcinogen (3).

Arsenic levels slightly above the chronic exposure comparison value for children were found in one sample of the Valles Mines Creek sediments near the former mill. Because this is a recreational area, it is visited infrequently. Residential use of this property is not expected and daily exposure does not occur; therefore, this site does not appear to be a health concern for arsenic. Adverse health effects are not expected to occur.

Cadmium

The exposure route of concern for cadmium at the Valles Mines Site is ingestion of contaminated soil, sediments, and surface water. Since the tailings piles are vegetated, inhalation exposure is not likely to occur and the contamination is not likely to be transported by the wind. Ingestion of high levels of cadmium in contaminated food or water can severely irritate the stomach, leading to vomiting and diarrhea, and sometimes death. Cadmium is a cumulative toxicant and ingestion of lower levels for a long period of time can lead to a buildup of cadmium in the kidneys and, possibly, kidney damage. The kidney is the main target organ for cadmium toxicity following chronic-duration exposure by oral routes (4).

The MRL for chronic ingestion of cadmium is 0.2 micrograms per kilogram per day (ug/kg/day) for adults. The current average dietary intake of adult Americans is approximately 0.4 ug/kg/day, and smokers take in about an equal amount from cigarettes (4). This indicates that Americans currently do not have a large margin of safety with respect to cadmium intake.

Cadmium was found in the soil and sediment from Valles Mines site in levels that are a concern for chronic exposure. Because this is a recreational area, it is visited infrequently and chronic exposure does not occur. This site does not appear to be a health concern for cadmium; therefore, adverse health effects are not expected to occur.

Lead

Lead is a naturally occurring metal found in the earth's crust. It has no characteristic taste or smell. It is mined and processed for use in various industries. 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 in paint. Lead was released into the air in automotive exhaust and deposited along roadways when it was in gasoline. Lead in the soils in the inner cities is often attributed to old houses containing lead paint (5). The practice of depositing mine tailings above ground has made a large volume of lead more accessible to people in former mining areas.

Exposure to lead can occur by inhalation or ingestion, with the effects on the body being the same. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure. Lead has the greatest effect on the nervous system, in adults and especially in children. Lead adversely affects the peripheral motor neurons causing weakness in fingers, wrists, and ankles. At high levels, lead can damage the brain and kidneys. Pregnant women can experience miscarriage if exposed to high levels of lead (5). Hypertension has also been associated with lead exposure in the general population. Lead and lead compounds are reasonably anticipated to be human carcinogens based on limited evidence from humans and sufficient animal studies (5).

The lead levels found in the soil and surface water at the Valles Mines site exceed levels that are typically acceptable for lead. Residents and visitors, especially children, who are regularly exposed, may be at risk for adverse health effects. It is recommended that exposure to the

contaminated soil and sediment only occur infrequently. Access to the areas with high concentrations of lead should be restricted.

Some residential yard and garden soil with the town of Valles Mines also contained elevated lead levels. It is recommended that residents, especially children, limit their contact with the contaminated soil. It is recommended that good personal hygiene, including hand washing, be practiced, especially after outdoor activities and before mealtime to prevent any hand-to-mouth transfer of contaminated soil.

Zinc

Zinc is a common element found in 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. Leafy vegetables contain minimal levels (2 ppm) and meats, fish, and poultry contain higher levels (29 ppm) (6). Zinc is also present in most drinking water. The levels can be higher if the water is stored in metal containers, or flows through pipes, coated with zinc to resist rust. Zinc is an essential element needed by the body in small amounts (6). 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 15 mg/day and for women, it is 12 mg/day (6). 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. It is unknown whether high levels of zinc affect the reproductive system or cause birth defects in humans (6).

Without adequate amounts of zinc in the diet, people may experience loss of appetite, decreased sense of taste and smell, decreased immune function, slow wound healing, and skin sores. Young men who have too little zinc in their diet can have poorly developed sex organs and retarded growth. Zinc is important for pregnant women to ensure their babies do not experience growth retardation (6).

Elevated levels of zinc were found in the soil and sediment from Valles Mines site. If visitors, especially children, were exposed daily over long periods of time (years) to soil or sediments from the site, they may be at risk for developing adverse health effects. Long-term exposure to the soil and sediments, including ingestion is not recommended. Because this is a recreational area, it is visited infrequently. Daily exposure does not occur; therefore, adverse health effects are not expected to occur.

Children's Health

In general, children are more likely than adults to be exposed to contaminants in soil or water. In their daily activities, children have a tendency to have frequent hand-to-mouth contact and introduce non-food items into their mouths. Because children are smaller and their bodies typically retain more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

Children are more susceptible to lead poisoning than adults and are more likely to be exposed to lead contaminated materials. When children are exposed to lead contaminated materials, a variety of adverse health effects can occur depending on the level of lead to which they are exposed and the duration of exposure. These effects include learning disabilities, slowed growth, hyperactivity, impaired hearing, and at very high exposure levels, even brain damage (5). Lead has the greatest effect on the nervous system, in adults and especially in children. In children, low levels of lead can cause weakness in fingers, wrists, or ankles. Unborn children can also be exposed to lead through their mothers and are at risk of premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (5).

Regular blood-lead testing before a child is six years old is key to determining if the child has been exposed. Eliminating exposure pathways by controlling contamination sources, practicing good personal hygiene, and eating a proper diet can help prevent lead poisoning in children.

Because of the characteristics of lead and the elevated levels found at this site, lead is the primary contaminant of concern. Long-term exposure to the lead contaminated soil can cause elevated blood lead levels in children. If contact does occur with the contaminated soil, proper hygienic measures should be conducted to prevent hand-to-mouth transfer of contaminated soil. These measures include hand washing, especially after outdoor activities and before mealtime. Shoes should be cleaned or removed before entering a home to avoid tracking lead from soil inside. Outdoor toys should also be cleaned to prevent the accumulation of lead contaminated soil on the toys and the tracking of it inside if the toys are brought into the home.

CONCLUSIONS

The surface soil in parts of the Valles Mines site contains lead at levels that are typically thought of to be of a health concern. Cadmium, and zinc are also present in the soil (Table 1). Sediment samples contained elevated levels of arsenic, cadmium, lead, and zinc. Unfiltered surface water in the two streams on-site also contains elevated levels of lead. Some residential yards and gardens in the town of Valles Mines also had lead levels above acceptable health protective levels.

Exposure to areas with high concentrations of lead should be limited. Periodic recreational visits to the site should not be a problem for visitors. However, visitors should avoid long-term contact with the soil, especially any contact that would lead to ingestion of the contaminated soil. Proper hygienic measures should be taken if exposure occurs. These measures include frequent hand washing, especially before mealtime. Shoes should be cleaned or removed before entering a

home to avoid tracking lead from soil inside. In addition to contamination at the site, some residential yards in Valles Mines have elevated levels of lead and zinc. Residents should limit contact with the contaminated soil in their yards. If residents come into contact with contaminated soil, the before-mentioned hygienic measures should be followed.

Primarily because of the contaminated surface soil, the Valles Mines site is classified as a *Public Health Hazard* for past and present exposures. Contamination was also found in the on-site surface water and sediment; however, chronic exposure to the surface water and sediments in the stream is not likely. The public health hazard classification is used for sites that pose a public health hazard because of the presence of hazardous substances at levels that could result in adverse health effects after long-term exposure. This classification is based on the following conclusions:

1. Lead was found in the surface soil at levels that are considered to be of health concern. Lead was also found to be elevated in surface water and sediments.

2. Visitors to the Valles Mines site for recreational purposes have direct access to most contaminated areas.

3. Some residential yards and gardens off-site, but within the town of Valles Mines, contained lead levels above levels considered to be of health concern.

4. The on-site lake, in which visitors fish and perhaps, consume fish that are caught, was not sampled for contamination.

RECOMMENDATIONS

1. DHSS/ATSDR recommends that exposure to areas with high concentrations of lead, cadmium, and zinc be limited. This could be accomplished by restricting access to the old smelter area and the other areas with highest concentrations.

2. DHSS/ATSDR recommends further sampling of the residential yards and gardens in the town of Valles Mines while limiting residential exposure to lead contaminated soil.

3. DHSS/ATSDR recommends health education for visitors concerning the health effects of lead exposure.

4. DHSS/ATSDR recommends sampling of the water, sediment, and fish in the on-site lake visitors regularly use for fishing.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for the Valles Mines site contains an explanation of the actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR, or other stakeholders at the site:

1. DHSS/ATSDR will coordinate with MDNR, the Jefferson County Health Department, and the Valles Mines Company to implement the recommendations in this public health consultation.

2. DHSS/ATSDR will coordinate with MDNR and the Jefferson County Health Department to address community health concerns and questions as they arise and provide necessary community and health professional education.

3. DHSS/ATSDR will update this public health consultation as needed.

Preparers of the Report:

Kristi Campbell, Cherri Baysinger, Missouri Department of Health and Senior Services

Certification

This Valles Mines site, Valles Mines, Missouri, Public Health consultation was prepared by the Missouri Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR

REFERENCES

1. Missouri Department of Natural Resources. Pre-CERCLIS Site Screening Report, Valles Mines Company Site, Jefferson County, Missouri. 2002 December 23.

2. Missouri Department of Natural Resources. Preliminary Assessment/Site Inspections/ Removal Assessment Sampling Report, Valles Mines Site, Valles Mines, Missouri, Jefferson County, 2004 May 27.

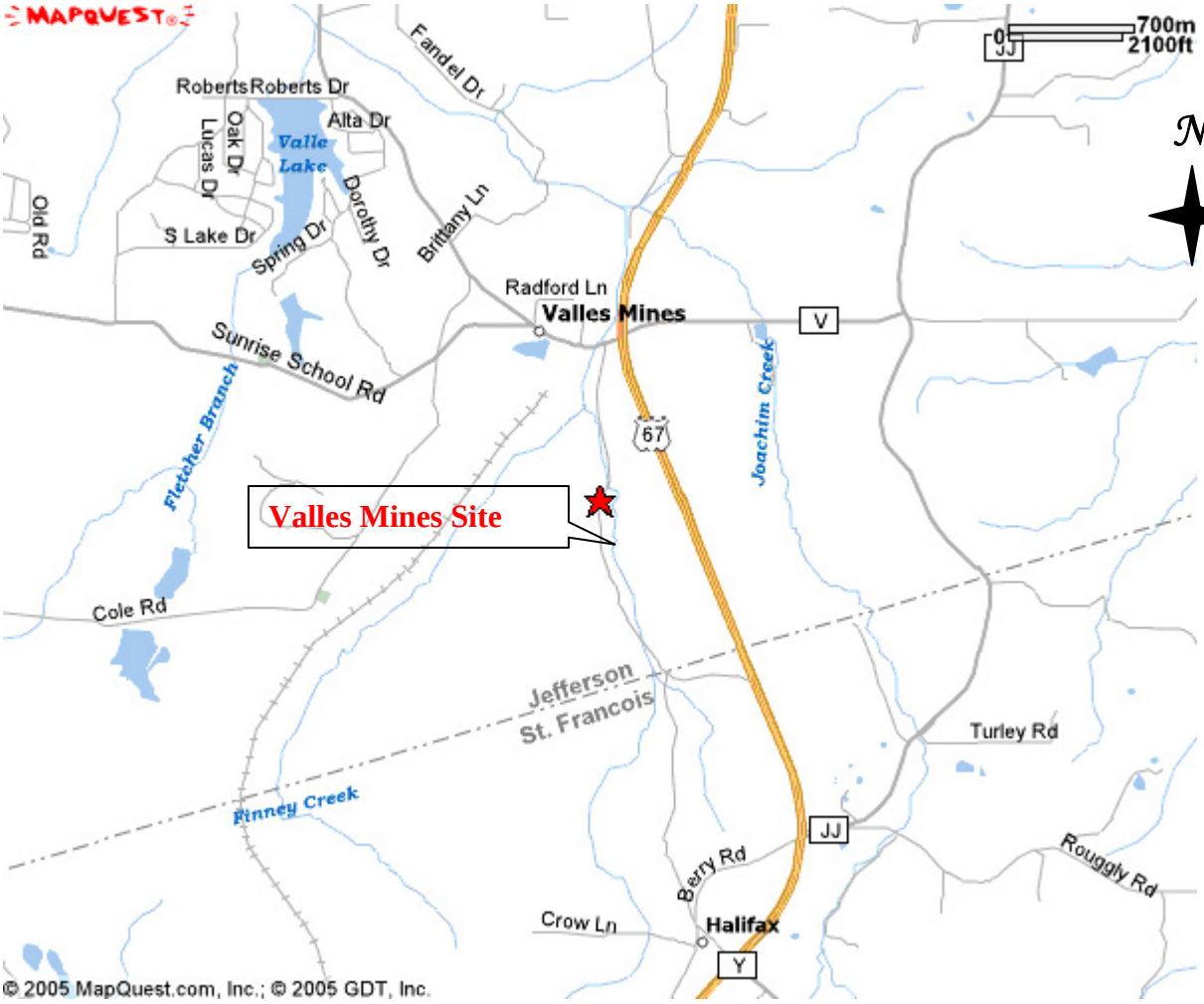
3. Agency for Toxic Substances and Disease Registry. Toxicological profile for arsenic, update. Atlanta: US Department of Health and Human Services; 2000 September.

4. Agency for Toxic Substances and Disease Registry. Toxicological profile for cadmium, update. Atlanta: US Department of Health and Human Services; 1999 July.

5. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead, update. Atlanta: US Department of Health and Human Services; 1999 July.

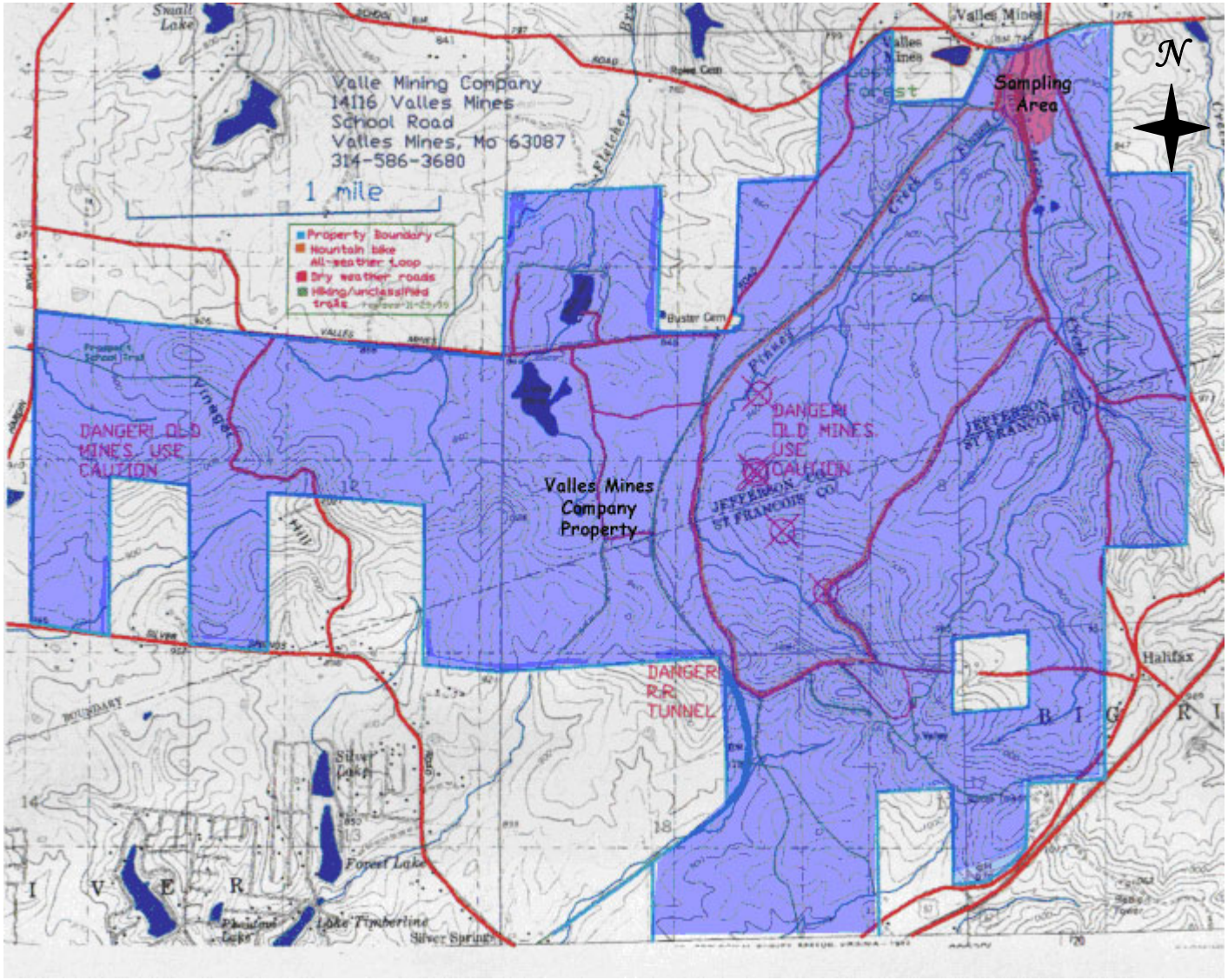
6. Agency for Toxic Substances and Disease Registry. Toxicological profile for zinc, update. Atlanta: US Department of Health and Human Services; 1994 May.

Figure 1. Map of Valles Mines Site Area



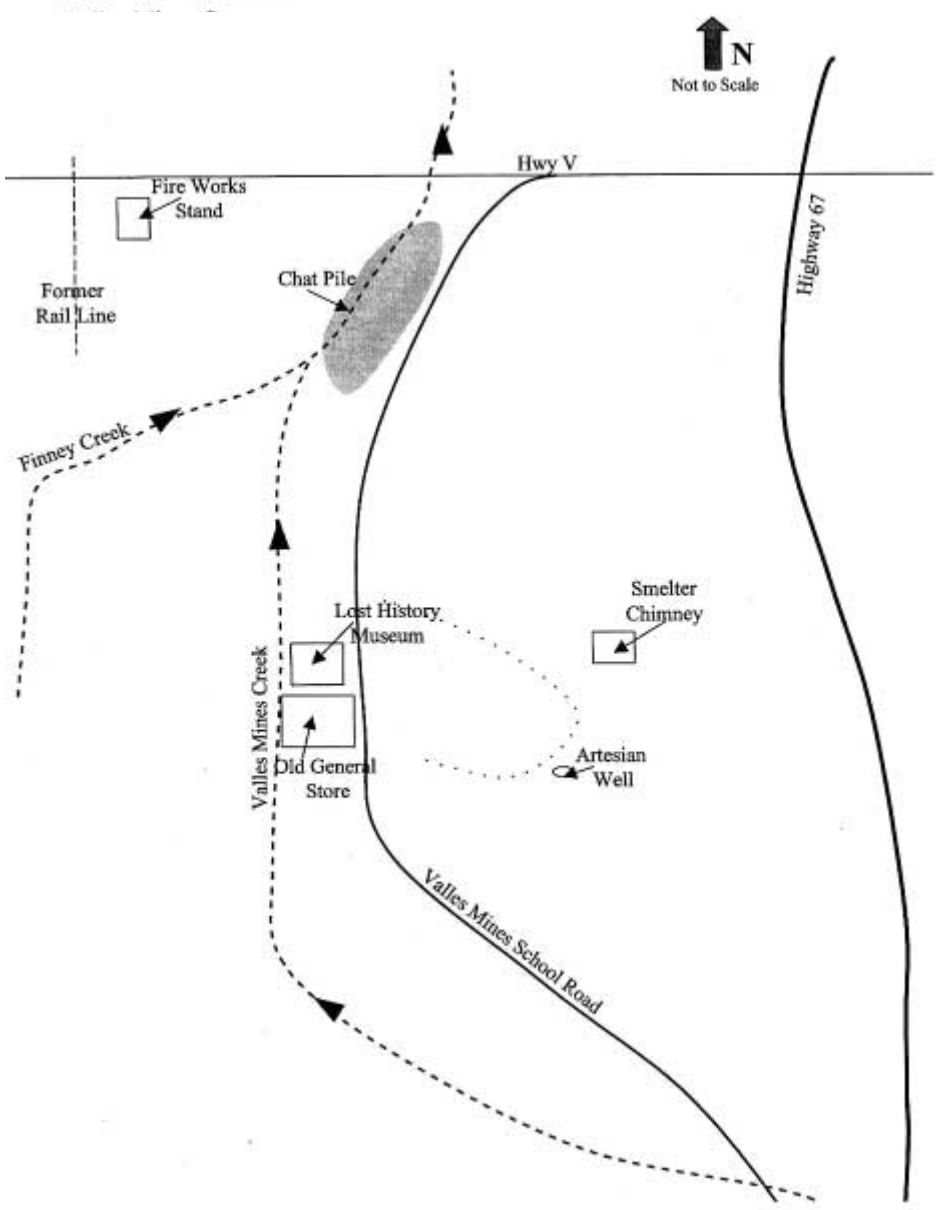
Modified from:
http://www.mapquest.com/maps/map.adp?searchtype=address&country=US&addtohistory=&searchtab=home
Valles+Mines+School+Road&city=Valles+Mines&state=mo&zipcode=63087

Figure 2. Map of Valles Mines Company Property Boundaries



Modified from: http://www.vallesmines.com/Downloads.html

Figure 3. Valles Mines Site Map



Modified from: Missouri Department of Natural Resources, Pre-CERCLIS Site Screening Report, Valles Mines Company Site, Jefferson County, Missouri. 2002 December 23.

Table 1. Selected Analytical Results for Soil Samples Collected at the Valles Mines Site, August 2002

Sample ID	SS-6	SS-5	SS-4	SS-3 Duplicate	SS-3	SS-1	SS-4 Bkgrd	CALM			EPA Action Level	
Laboratory Number	0219307	0219311	0219314	0219313	0219315	0219318	0219312	Res.	Ind.	C_{LEACH}	Time Critical	Non-Time Critical
Cadmium	**26.7**	**57.9**	**106**	**130**	**64.3**	**4.73**	1.3	110	380	11	NA	NA
Lead	**14,300**	3,900	**44,200**	**41,600**	**50,800**	2,450	1,800	260	660	NA	1,200	400
Zinc	1,040	**37,700**	**58,100**	**60,200**	**58,800**	2,410	968	38,000	130,000	3,000	NA	NA

All values are in parts per million (ppm) or milligrams per kilogram (mg/kg).
NA = benchmark value not available.
Values in bold are three times greater than the background level.
Shaded values exceed one or more of the comparison values.
ATSDR soil comparison values not available for lead.
CALM= MDNR Cleanup Levels for Missouri.

Table 2. Selected Analytical Results for Sediment Samples Collected at the Valles Mines Site, August 2002

Sample ID	SED-1	CALM			EPA Action Level	
Laboratory Number	0219309	Res.	Ind.	C_{LEACH}	Time Critical	Non-Time Critical
Cadmium	35.3	110	380	11	NA	NA
Lead	3470	260	660	NA	1,200	400
Zinc	39100	38,000	130,000	3,000	NA	NA

All values are in parts per million (ppm) or milligrams per kilogram (mg/kg).
NA = benchmark value not available.
Shaded values exceed one or more of the comparison values.
ATSDR soil comparison values not available for lead.
CALM= MDNR Cleanup Levels for Missouri.

Table 3. Selected Analytical Results for Surface Water Samples Collected at the Valles Mines Site, August 2002

Sample ID	W-4	W-5	W-5 Duplicate	W-2	W-3 Bkgrnd	MCL	ATSDR RMEG
Laboratory Number	**0219306**	**0219304**	**0219303**	**0219310**	**0219308**		
Cadmium, dissolved	<1	<1	<1	<1	<1	5	5 (child)
Cadmium	<1	<1	<2	<1	<1	5	20 (adult)
Lead, dissolved	4.17	5.76	5.87	3.16	<2	15*	NA
Lead	<25	<25	<25	<25	<10	15*	NA
Zinc, dissolved	120	115	114	132	83.5	NA	3000 (child)
Zinc	138	136	143	135	80.8	NA	10,000 (adult)

*EPA action level for lead.
MCL= EPA's Maximum Contaminant Level
All values are in parts per billion (ppb) or micrograms per liter (µg/L).
NA = benchmark value not available.
Values in bold are three times greater than the background level.
Shaded values exceed one or more of the comparison values.

Table 4. Selected Analytical Results for GroundWater Samples Collected at the Valles Mines Site, August 2002

Sample ID	W-1	W-1 Duplicate	MCL	ATSDR RMEG
Laboratory Number	**0219317**	**0219316**		
Cadmium, dissolved	<1	<1	5	5 (child)
Cadmium	<1	<1	5	20 (adult)
Lead, dissolved	4.12	3.26	15*	NA
Lead	<10	<10	15*	
Zinc, dissolved	151	147	NA	3000 (child)
Zinc	133	133	NA	10,000 (adult)

*EPA action level for lead. RMEG=Reference Dose Media Evaluation Guide
MCL= EPA's Maximum Contaminant Level
All values are in parts per billion (ppb) or micrograms per kilogram (µg/L).
NA = benchmark value not available.
Shaded values exceed one or more of the comparison values.
Values in bold are three times greater than the background level.

Table 5. Selected Analytical Laboratory Results for Soil Samples Collected from Yards in Valles Mines and at the Valles Mines Site, May 2004

Sample ID	Laboratory Number	Lead	Cadmium	Zinc
Background 1	**0411599**	102	<0.1	70.3
Background 2	**0422831**	151	<1.0	58.3
01 (Valles Mine Residence)	**0422836**	**759**	**4.33**	**2,020**
02 (Valles Mine Residence)	**0422940**	**487**	**2.4**	**1,180**
02 (Valles Mine Residence)	**0422835**	**1,290**	**6.65**	**3,380**
02 (Valles Mine Residence)	**0422941 (rep)**	**1,320**	**9.28**	**5,300**
02 (Valles Mine Residence)	**0422832**	**563**	**2.87**	**1,440**
05 (Valles Mine Residence)	**0422833**	346	**1.22**	**374**
06 (Valles Mine Residence)	**0422834**	84.1	<1.0	55
Recreational Center	**0417596**	**2,890**	**5.34**	**3,770**
EPA Removal Action Level				
Time Critical		1,200	NA	NA
Non-Time Critical		400	NA	NA
CALM Values				
Residential		260	110	38,000
Industrial		660	380	130,000
C_{LEACH}		NA	11	3,000
ATSDR EMEG Chronic		NA	10 (child) 100 (adult)	20,000 (child) 200,000 (adult)

All values are in parts per million (ppm) or milligrams per kilogram (mg/kg).
NA = benchmark value not available.
Values in bold are at least three times greater than the background level.
Shaded values exceed one or more of the comparison values.
ATSDR soil comparison values not available for lead.
EMEG=Environmental Media Evaluation Guide.
Chronic = exposure that occurs for more than one year.
CALM= MDNR Cleanup Levels for Missouri.

Table 6. Sampling Results for Sediment Samples Collected from the Valles Mines Site, May 2004

Sample ID	Arsenic	Lead – TCLP	Lead-Total	Cadmium-TCLP	Cadmium-Total	Zinc-Total
0417575	9.4	3.72	779		3.21	1,490
0417577	10.9	1.03	4,790		1.67	995
0417579	24.2	36.7	4,340		13.90	17,900
0417581	12.4	44.4	4,520		14.70	8,920
0417583	9.39	0.30	143		8.02	282
0417585	7.62	23.5	1,210		12.00	5,710
0417587	8.75	21.6	1,290		6.04	3,630
0417589	16.9	5.92	1,990	0.15	21.40	11,300
EPA Removal Action Level						
Time Critical	NA		1,200	NA	NA	NA
Non-Time Critical	NA		400	NA	NA	NA
ATSDR EMEG Chronic	20 (child) 200 (chronic)		NA		10 (child) 100 (adult)	20,000 (child) 200,000 (adult)

All values are in parts per million (ppm) or milligrams per kilogram (mg/kg).
NA = benchmark value not available.
Values in bold are three times greater than the background level.
Shaded values exceed one or more of the comparison values.
ATSDR soil comparison values not available for lead.
EMEG=Environmental Media Evaluation Guide.
Chronic = exposure that occurs for more than one year.

Table 7. Sampling Results for Soil Samples Collected from the Valles Mines Site, May 2004

Sample ID	Lead-Total	Cadmium-Total	Zinc-Total
0417591	**8,050**	**16.5**	**15,300**
0417592	**677**	**1.17**	**763**
0417593	**20,800**	**21.8**	**13,700**
0417594	**29,700**	**174**	**71,800**
0417595	**21,500**	**101**	**99,000**
0417596	**2,890**	**5.340**	**3,770**
0417597	**4,680**	**59.1**	**32,600**
0417598	**805**	**2.87**	**3,590**
0417599*	102	0.1	70.3
0422831*	151	0.357	58.3
0422837	**19,700**	**36.9**	**1,880**
0422838	89	0.1	111
0422839	**1,010**	**7.230**	**1,800**
EPA Removal Action Level			
Time Critical	1,200	NA	NA
Non-Time Critical	400	NA	NA
ATSDR EMEG Chronic	NA	10 (child) 100 (adult)	20,000 (child) 200,000 (adult)
CALM Values			
Residential	260	110	38,000
Industrial	660	380	130,000
C_{LEACH}	NA	11	3,000

*Background samples.
All values are in parts per million (ppm) or milligrams per kilogram (mg/kg).
NA = benchmark value not available.
Values in bold are three times greater than the background level.
Shaded values exceed one or more of the comparison values.
ATSDR soil comparison values not available for lead.
EMEG=Environmental Media Evaluation Guide.
Chronic = exposure that occurs for more than one year.
CALM= MDNR Cleanup Levels for Missouri.

Table 8. Sampling Results for Surface Water Samples Collected from the Valles Mines Site, May 2004

Sample ID	Lead – Dissolved	Lead-Total	Cadmium-Dissolved	Cadmium-Total	Zinc-Dissolved	Zinc-Total
0417574	4.33	17.5	0.25	0.25	41.2	143
0417576	8.78	22.7	0.25	0.25	85.5	136
0417578	8.39	22.7	0.25	0.32	86.9	128
0417580	7.86	23.9	0.25	0.25	85.9	136
0417582	1.99	4.33	0.25	0.25	2.70	11.6
0417584	8.77	31.8	0.25	0.35	75.9	145
0417586	6.77	25.2	0.25	0.25	54.5	112
0417588	4.82	18.5	0.25	0.27	68.8	117
0417590 (drinking water)		0.28		0.60		99.1
EPA MCL	15	15	5	5	5000	5000
ATSDR RMEG	NA	NA	5 (child) 20 (adult)	5 (child) 20 (adult)	3000 (child) 10,000 (adult)	3000 (child) 10,000 (adult)
AWQC/ AALAC	3.2	3.2	1.1	1.1	110	110
MO WQS **DW/GW** **Aquatic Life**	 15 9	 15 9	 5 9.1	 5 9.1	 5000 241	 5000 241

All values are parts per billion (ppb) or micrograms per liter (µg/L).
NA = benchmark value not available.
Values in bold are three times greater than the comparison level.
Shaded values exceed one or more of the reference values.
EPA= Environmental Protection Agency
MCL= Maximum Contaminant Level
RMEG= Reference Dose Media Evaluation Guide.
AWQC/AALAC= Ambient Water Quality Criteria/ Ambient Aquatic Life Advisory Concentrations (EPA)
MO WQS= Missouri Water Quality Standards (MDNR).
DW/GW= Drinking water / ground water
Aquatic Life= protection of aquatic life