ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

MADISON COUNTY MINES SITE
MADISON COUNTY, MISSOURI
EPA FACILITY ID: MOD098633415
DECEMBER 6, 2005

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

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

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PUBLIC HEALTH ASSESSMENT

MADISON COUNTY MINES SITE

MADISON COUNTY, MISSOURI

EPA FACILITY ID: MOD098633415

Prepared by:

Missouri Department of Health and Senior Services
Division of Community and Public Health
Section for Environmental Public Health
under cooperative agreement with the
Agency for Toxic Substances and Disease Registry

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SUMMARY

The Madison County Mines site is located approximately 90 miles south of St. Louis, Missouri, in an area of southeast Missouri known as the "Old Lead Belt." Lead was discovered and mined in the area beginning in the 1700s and continuing into the mid 1900s. Lead was the predominant material mined, but copper, cobalt, nickel, iron, zinc, and silver were also mined at some locations. Past mining operations at the Madison County Mines site have left at least 13 major tailings and chat deposits from mineral processing and/or smelting operations within the county. The majority of the abandoned mine workings are located within six miles of each other and cover approximately 645 acres around the city of Fredericktown (See Appendix A, Figure 1). Two types of mine waste are present in the Fredericktown area: chat and tailings. Chat is the mining waste material produced when using the dry gravity separation method. Chat is mechanically disposed of in large piles. In contrast, tailings are finer and are the waste material resulting from a wet flotation process. Tailings are generally held in dammed impoundments. Both chat and tailings contain elevated concentrations of metals, predominantly lead. In this public health assessment, chat and tailings will be referred to as tailings for simplicity.

Past mining activities, along with the migration of the tailings, have contaminated residential yards, surface water and sediment in streams, groundwater, and air. The tailings have migrated from the tailings areas by natural and human activities to areas where exposure is more likely to occur. Lead is the primary contaminant of concern associated with the tailings. Although other metals have been detected in certain portions of this site, insufficient data exist to determine possible health risks. Human exposure has occurred to these media at areas in and around the city of Fredericktown. Because of this exposure and the contaminated tailings, the Environmental Protection Agency (EPA) proposed the site for listing on the National Priorities List on April 30, 2003. The listing was finalized on September 29, 2003. To better address the different tailings areas with different potentially responsible parties, the Madison County Mines site is broken down into three Operable Units (OUs) that will be considered separately. Some sampling has been completed in each OU. Results of completed sampling events are discussed under each OU. Additional sampling is planned for all OUs. A summary of the past sampling results can be found in Appendix B, Table 1 and 2.

At the Madison County Mines site, exposure to lead contamination has been the major problem, especially to children less than six years of age. Blood-lead levels in 6% of the children less than six years of age are elevated at this time. Remediation of residential yards in Fredericktown and Madison County with elevated lead levels is presently being conducted under an EPA Time-Critical Removal Action. This action is intended to prevent children from being exposed to site related contaminants. A similar removal action took place in 2001 at the Harmony Lake area to prevent exposure to lead at that location. Because lead-contaminated tailings remain throughout the area, exposure continues to occur. Also, the full extent of contamination, effects to the environment and possible exposures to humans have not been fully evaluated, although further investigations are planned. Because of the ongoing exposure to lead and potential future exposures, the site has been classified as a public health hazard for the past, present, and future. The category of a public health hazard is assigned to sites that pose a public health hazard as the result of long-term exposures to hazardous substances. See Appendix C for an explanation of terms and acronyms.

PURPOSE AND HEALTH ISSUES

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), is evaluating the public health impact of the Madison County Mines site. This public health assessment will determine if exposures have occurred in the past, present, or future at a level of health concern and recommend actions to reduce or prevent possible adverse health effects. ATSDR is a federal agency within the U.S. Department of Health and Human Services and is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct public health assessments at hazardous waste sites.

BACKGROUND

Site Description and History

The Madison County Mines site is located approximately 90 miles south of St. Louis, Missouri, in an area of southeast Missouri known as the "Old Lead Belt." Lead was discovered and mined in the area beginning in the 1700s and continuing into the mid 1900s (1). Lead was the predominant material mined, but copper, cobalt, nickel, iron, zinc, and silver were also mined at some locations (2). Past mining operations at the Madison County Mines site have left at least 13 major tailings and chat deposits from mineral processing and/or smelting operations within the county (3). The majority of the abandoned mine workings are located within six miles of each other and cover approximately 645 acres around the city of Fredericktown. The major tailings areas are mostly located in remote areas with few residents located nearby. The exceptions are two tailings areas that have vacation dwellings or recreational facilities. See Figure 1 for location of the site and major tailings areas. Two types of mine waste are present in the Fredericktown area: chat and tailings. Chat is the mining waste material produced by using the dry gravity separation method and mechanically disposed of in large piles. In contrast, tailings are finer and are the waste material resulting from a wet flotation process and are generally held in dammed impoundments (1,2). In this public health assessment, chat and tailings will be referred to as tailings for simplicity.

Past mining activities and the migration of metal-contaminated tailings (mostly lead contamination) by natural and human activities into driveways, residential yards, surface water and sediment in streams, groundwater, and air have allowed human exposure to occur. The tailings were used in residential areas for fill, driveways, and play areas, where residents and especially children could easily be exposed. EPA has developed a fact sheet on proper and improper uses of mine waste to help eliminate future exposure pathways (See Appendix D).

Past sampling has determined that lead is the primary contaminant of concern in the tailings. Although other metals have been detected in certain portions of this site, insufficient data exist to determine possible health risks. To eliminate exposure to lead-contaminated soils in the city of Fredericktown, the EPA is conducting a time-critical removal action of contaminated residential soils. Because of the potential for exposure to residential soils and the wide-spread contamination, the Environmental Protection Agency (EPA) proposed the site for listing on the National Priorities List on April 30, 2003. The listing was finalized on September 29, 2003.

The Madison County Mines site has been broken down into three Operable Units (OUs), which will be discussed in this public health assessment along with the Fredericktown Time Critical Removal and an old lead processing facility previously investigated. Operable Units -1 and -2 have a potentially responsible party (PRP) that is performing remedial actions at the sites. A PRP has not been identified for OU-3; therefore, EPA will conduct needed investigations and necessary remedial actions at OU-3. Pathways of human exposure in each of the OUs are the same. Exposure is through the ingestion or inhalation of lead-contaminated tailings that have been placed on the land surface or moved where human can come into contact with them. The OUs are broken up into the following designations:

Operable Unit 1 (OU-1) includes the following tailings/mine areas:

- Mine La Motte tailings,
- Harmony Lake tailings pile, Harmony Lake, and the Harmony Lake Association Property,
- Basler tailings area, and the
- Old Jack Mine.

Operable Unit 2 (OU-2) consists of the:

- Anschutz Mining Corporation Property

Operable Unit 3 (OU-3) includes the following tailings piles and/or other areas of tailings:

- Conrad tailings,
- Skaggs tailings,
- Catherine tailings (also being used as a repository for removed yard soils),
- Little St. Francois River tailings and an aerial tramway,
- Remaining residential yards and driveways in Fredericktown and residential properties in other portions of Madison County,
- Silvermines,
- Airport, and
- other areas and yet undiscovered tailings areas and environmental media that need to be evaluated.

Fredericktown Time-Critical Removal Action: Consists of screening and cleanup of residential yards and other areas with elevated lead levels that require an expedited cleanup (sub-site of the Madison County Mines site).

Old Lead Processing Facility: Private property not included in the OUs, but located near the Mine La Motte tailings area and contaminated with high levels of lead contamination.

Operable Units at the Madison County Mines site

Operable Unit 1 (OU-1)

This unit consists of three tailings areas that cover approximately 300 acres and an abandoned mine works north of the city of Fredericktown (See Figure 1). The tailings areas range from being in close proximity to residences to being almost completely isolated. In one area, people camp on the tailings. An area of private property that was once used as a lead processing facility was included in an earlier sampling event, but is not included in OU-1. This property is located northeast of the Mine La Motte tailings.

These areas were investigated by EPA in a 1995 Expanded Site Inspection (2) and later by the PRP in a 1999 Characterization Study Work Plan (1,4). The Characterization Study was conducted under an Administrative Order on Consent between the PRPs and EPA to determine the extent of contamination, the effect on the environment, and the potential for the sites to affect public health.

To evaluate the contaminant levels in different environmental media, samples were taken of the tailings, sediment, residential soils, other soils, surface water, groundwater, and fish. The sampling methods and locations were described in the 1999 Characterization Study Work Plan, and sampling results were taken from the February/April 2000 preliminary sampling data (1,4). DHSS reviewed the sampling data in a January 19, 2001, ATSDR health consultation. The health consultation concluded that lead was present at levels of health concern. The health consultation recommended that exposure be eliminated, investigations continue, and remediation be considered on contaminated areas (5).

Tailings were sampled using composite (multiple) samples at the 0 to 2-inch and 5-foot depths for analysis in the laboratory and in the field with an X-ray fluorescence (XRF) detector. Soils were screened using the XRF. A discrete (single) sample (0 to 2 inches) was collected and laboratory analyzed for heavy metals. Filtered and unfiltered surface water samples were collected from the lakes and streams of OU-1 and analyzed. The filtered samples were taken to determine dissolved metals concentrations and the unfiltered samples to determine the total amount of metals in the water. Sediment samples were collected from the top 3 inches of sediment after first removing any protruding debris. Fish samples were collected from two water bodies associated with the tailings piles (Harmony Lake and the “Slime Pond”), and downstream from the tailings piles in various streams. Fish samples were also taken from streams not affected by the tailings sites and used for background samples (1,2,4). Analyses for metals

included whole body fish and fish filets, but did not include all species of fish. Because the filet is the part of the fish that is generally eaten, only sampling results of the fish filets were used in the January 2001 health consultation.

In this public health assessment, sampling results are compared to Cleanup Levels for Missouri (CALM), ATSDR's Comparisons Values, EPA's Public Drinking Water Standards (PDWS), or the World Health Organization (WHO) safe level for lead in fish. The CALM value for unrestricted land use was used, which includes residential use. This is a health-based value that represents the maximum concentration of a chemical that is acceptable in the soil, regardless of future land use. Only lead and arsenic levels were found to be above the screening value. See Table 1 for a summary of lead and arsenic levels detected from areas in OU-1.

The areas of OU-1 consist of the:

Mine La Motte tailings area:

The Mine La Motte tailings area consists of approximately 495 acres that are owned by the Mine La Motte Recreation area, of which approximately 250 acres are covered with tailings (See Figure 1). There is also an approximately 100-acre pond (known as the "Slime Pond"). In the past, the area was used for producing and processing lead. Currently the property is used for recreational purposes including swimming, fishing, camping, boating, and hunting. The beach and approximately 50 camping sites are located on the western and southern areas of the lake on tailings. A children's playground is located in the tailings of the beach area. Lead levels were found at a maximum of 1,130 ppm in the surface (0-2 inches) tailings of the beach and camping areas (3,4). The tailings pile to the east and northeast of the lake is used for recreational purposes such as riding all-terrain vehicles (ATVs). Lead levels in the tailings were detected at a maximum of 24,400 ppm in surface samples (3,4), but exposure in this area is less likely than at the beach and camping area. The Mine La Motte Recreation Association has approximately 400 members who spend various amounts of time at the site, ranging from a few days of recreation on weekends to the majority of the summer (2).

Exposure to lead contaminated tailings via ingestion and inhalation is expected to occur in this area because of the activities on the tailings. The Madison County Health Department has provided educational and cleaning materials to help lessen exposures. Physical hazards at the site include drop-offs and old timbers that protrude from the tailings.

Harmony Lake tailings, Harmony Lake, and Harmony Lake Association property:

The Harmony Lake area includes a lake that is used for recreation and residential areas on the west and east shores of the lake (See Figure 1). EPA reports that there are approximately 75 homes in the area, 50 are full-time residences and the rest are used intermittently. Sampling of a portion of these private residences found lead concentrations of 166 to 19,100 parts per million (ppm) in yard soil. Approximately 30 acres of tailings are located south of the lake across a county road. Lead concentrations in surface samples (0-2 inches) at a maximum of 35,000 ppm

were detected in these tailings (3,4). North of the site is a wooded area that provides most of the watershed for the lake. EPA conducted a time-critical removal action in 2000 and 2001 to remove contaminated soil/tailings from residential yards. Yards with lead levels equal to or greater than 400 ppm were remediated to eliminate exposures to contaminated soils (6,7). The removal action also remediated the tailings pile by regrading the slopes, covering the tailings with one foot of clean soil, and re-vegetating. With the completion of the time-critical removal action, exposure to the lead-contaminated tailings should have been eliminated. Before and after photos of the remediated Harmony Lake Tailings site can be seen in Figure 2.

Basler tailings pile:

The Basler tailings pile site is located in a wooded area with no residences in the vicinity. It is adjacent to Copper Mines Road, 0.25 miles east of US Highway 67 (See Figure 1). The site consists of approximately 20 acres of tailings and a flooded abandoned mineshaft that slopes into a hillside. Lead concentrations were found at a maximum of 10,200 ppm in surface samples (0-2 inches) of the tailings. Surface soil samples taken along a transect leading away from the edge of the tailings also contained elevated lead concentrations (3,4). Sediment and surface water samples were taken from the stream that drains the Basler tailing pile and found to have elevated levels of lead (1,4). The area is only used infrequent for hunting, thus exposure should be limited. Physical hazards may include drop-offs, old equipment, and an open water-filled mine shaft.

Old Jack Mine:

The Old Jack Mine was developed in the mid 1800s and is located 0.6 miles northwest of the Mine La Motte tailings. The site consists of two open pits. Lead was detected at the site at a maximum of 22,000 ppm in a surface sample from the pits area (3,4). The pits and surrounding area are vegetated with trees, shrubs, and grasses with no residences in the near vicinity (1,4). Although the site is accessible, little human activity is presently occurring at the site, and site use is not expected to change.

Other Associated Areas with OU-1

Private property northeast of the Mine La Motte tailings pile was also sampled and found to have the highest detected lead levels from the 1999 Characterization Study Work Plan. This area has not been included in OU-1 and is discussed further under the private property northeast of the Mine La Motte tailings.

Local Streams

Samples of the local streams draining the tailings areas and upstream samples not affected by the tailings were taken to determine if the tailings sites are having an effect on the streams. Sampling included grab samples of surface water that were unfiltered and filtered, sediment samples, and fish samples.

All of the streams that drain the tailings areas of OU-1 ultimately drain into the Little St. Francois River. This river flows into the Fredericktown City Lake from which the city of Fredericktown obtains it public water supply. Flow from the Mine La Motte tailings empties into the Little St. Francois River below City Lake. Available data from the Missouri Department of Natural Resources, Public Drinking Water Program, indicate that lead has not been found in the Fredericktown public water supply (5).

Results from surface water samples of the local streams indicated an increased level of lead in the unfiltered samples downstream (ND to 100 ppm) as compared to upstream (ND to 14 ppm) samples. Filtered samples of stream surface water were almost always non-detectable for lead, indicating that the lead was in suspension rather than dissolved in the water. Results of the sediment sampling again indicated an increased level of lead in downstream samples (61 ppm to 7,610 ppm) compared to upstream (24 ppm to 155 ppm with one sample having 4,850 ppm that may be influenced by tailings) samples that were taken (5).

Fish Sampling

Samples of fish were taken at 10 locations including Harmony Lake, the lake at Mine La Motte, background streams not affected by the tailings, and the Little St. Francois River that drain the tailings piles. However, few bottom-feeding fish were sampled leaving a data gap for these types of fish. One Yellow Bullhead catfish caught in the Little St. Francois River did contain lead at 698 ppb in the filet. In general, the fish samples analyzed did not have lead contamination in the filets above 200 parts per billion (ppb). Two hundred ppb is the World Health Organization guideline for lead in fish filets (8). Whole body fish samples usually had a much higher lead content (5). Fishing is expected to take place in the Little St. Francois River, in the lower tributaries that feed into the Little St. Francois River, and in pools of the streams that drain the tailings areas. Access to the drainage area of the tailings is mostly unrestricted.

Operable Unit 2 (OU-2)

The Anschutz property (the original Madison Mine site) has been used for mining since the mid-1840s when the property was first mined for copper. The land has also been mined for lead, cobalt, nickel, iron, zinc, and silver, and has been owned and operated by various companies over the years. Anschutz purchased the property in 1979. The property covers approximately 1,750 acres and is completely fenced. The northern portion of the site was disturbed by past mining operations. This site consists of five main tailings piles that cover approximately 200 acres, several ponds (including the Metallurgical (Met) pond), and remnants of a mill, smelter, and refinery complex (2). Access to the site is restricted, but contaminants have migrated offsite.

Lead was smelted on the property from 1907 to 1910, and then again from 1917 to 1920. Slag from the smelting consists of various oxides, including those of lead and silicon. A refinery to recover copper, nickel, and cobalt from the concentrates operated until 1962. The refinery building is still present on-site. The primary contaminants from the refinery activities are heavy metals that were disposed of in the tailings piles (9). A number of tailings piles have been

covered with a soil cap and seeded to prevent their release into the environment (personal observation during 1999 site visit).

There are two intermittent creeks that flow through the Anschutz property, Tollar Branch and an unnamed tributary of Saline Creek. The Tollar Branch is an intermittent creek that flows through the Anschutz property and through Fredericktown before emptying into Saline Creek. In 1977, a tailing dam collapsed allowing the contents to flow down Tollar Branch (2). Reports from local residents also told of past instances where the creeks flowing from the site have been colored during times of high water (Resident comments at Madison Co. Roundtable, March 2003).

In 1961, an angled mine shaft ("the Decline") from the surface to the underground mine workings was constructed to remove equipment from the mine for salvage. After the equipment was removed, the mine was allowed to flood. Once pumping of the groundwater from the mine stopped, the groundwater level rose to above the tip of the decline where it flowed onto the surface and into Goose Creek. Goose Creek later joins Saline Creek. The flow rate was approximately 60 gallons per minute from the Mine Decline into Goose Creek (9). Goose and Saline Creeks were placed on Missouri's 1998-303(d) list of affected streams because of elevated levels of nickel and cobalt from the mine (10). Sometime between 2001 and 2002, the PRPs for the Anschutz property had the entrance to the Mine Decline blocked off, stopping the flow of mine water into the creeks (9). During early 2003, residents in the area starting noticing that mine water was coming out of vent pipes and exploratory wells. Even a private well (not used for drinking water) had become artesian (water that surfaces from a drilled hole). In April 2003, six private wells in the area were sampled. Only the well known to be in contact with mine water had elevated levels of nickel, cobalt, and manganese. Later in 2003, reports of the artesian wells subsided, but it is not known if the groundwater level dropped or if another pathway for the mine water to exit the mines was created.

Beginning in 1979, the PRP performed a number of studies to define the environmental conditions in and around the mine site. Three studies were completed, in 1981, 1988, and 1989. Since 1992, storm water discharge has been monitored (9).

EPA has requested the PRP of OU-2 of the Madison County Mines site to determine the present nature and extent of contamination and any threat to the public health, welfare, or the environment caused by release or threatened release of hazardous substances, pollutants or contaminants at or from the site. The PRPs are preparing a work plan for a Characterization Study for OU-2, which will be reviewed by EPA and associated agencies. An Administrative Order on Consent in which the PRPs agree to do the requested work for OU-2 is expected to be included in an addendum to the work plan.

Operable Unit 3 (OU-3)

Because no PRP has been identified for the remaining tailings and contaminated areas, EPA has developed a Statement of Work for actions that need to be completed in the areas not covered under OU-1 and OU-2. EPA has hired a contractor to complete those actions, with activities initiated in early 2005.

Operable Unit 3 consists of four tailings piles of various sizes, the Conrad, Catherine, Skaggs, and the Little St. Francois River tailings piles. Also included in OU-3 are mining facilities and equipment, an aerial tramway, streams, ponds, roads, streets, right-of-ways, groundwater wells, residences, driveways, public areas, a state recreation area, possible mine outflows, an area near the airport, a soil repository, and possible assorted smaller areas of lead contamination. The Statement of Work for OU-3 is divided into four phases of work.

Phase 1 of the OU-3 activities will include investigation of residences and other areas in the City of Fredericktown and Madison County that were not previously investigated, residences with over 1200 ppm of lead that has not been remediated, and those residences with lead levels found to be between 400 and 1,200 ppm. It will also include organizing data from other investigations and filling data gaps. Impacts from the contamination in the different environmental media will also be evaluated.

The Little St. Francois River tailings site will also be included in Phase 1 (3). This site is a small tailings area of approximately one acre that is situated on the banks of the Little St. Francois River. Because of the potential of further erosion of the tailings pile, the site was included in Phase 1. Access to the Little St. Francois River tailings area is limited, but trespassers have been known to access the area. Little exposure is expected to occur at the site.

Phase 2 will consist of evaluating and investigating the Conrad tailings site to determine its effects on the environment and investigate the potential for stabilization of the pile. The Conrad tailings cover approximately 50 acres and consist mostly of very fine-sized tailings that have been highly eroded. Surface water flow has eroded tailings into an intermittent creek and eventually into Mill Creek. Numerous physical hazards exist at the Conrad site, including deteriorating holding and drainage structures (2,3). The site is remote and on private property with limited access. Trespassing has occurred, but little exposure is expected to have taken place on the tailing site.

Phase 3 will consist of evaluating and investigating the Catherine and Skaggs tailings sites. At the Catherine site, the chat piles covered approximately 60 acres with the material ranging in size from gravel to large boulders. There was an abandoned building and a small reservoir of approximately 30 acres on-site. The Catherine site was used as a repository for the lead-contaminated yard soils removed from contaminated yards in Fredericktown as part of a Removal Action for contaminated yards. The repository will be permanently closed during Phase 3 and the site will be used for administrative and/or stockpiling operations of a commercial limestone quarry. The physical hazards were removed when the site was prepared for use as a soil repository. The Skaggs site consists of approximately 15 acres of tailings that has some areas covered with sawdust from an on-site sawmill, vegetation, or limestone and tailings. An intermittent creek flows across the southern portion of the property and tailings have been observed downstream of the site (2,3). Access is limited, but trespassing could occur. Exposure on the site is expected to be limited, but physical hazards like old mining structures and equipment remain.

Phase 4 consists of the investigation of contaminated media, and if necessary, the remediation of the remaining areas at the Madison County Mines site. This may include the Fredericktown airport, the "silver mines" area and other areas as-yet-unnamed.

One of the first activities was for EPA to offer free screening of private yards throughout Madison County. EPA sent letters to residents in late 2004 and early 2005 offering the screening. The purpose is to determine if heavy metals contamination associated with the tailings/mining are present and if they pose a health risk to residents of Madison County.

Fredericktown Time-Critical Removal Action

Residential yards with elevated lead levels in and around the city of Fredericktown are being remediated under an EPA Time-Critical Removal Action that is separate from the OUs. This action was initiated to eliminate critical exposure pathways in an expedited manner. It came about because the Madison County Health Department is actively involved in screening children for elevated blood lead levels and determining the source to prevent continued exposure. In 2000, the health department alerted EPA that a number of children with elevated blood-lead levels were present in combination with elevated lead levels in residential yard soil. Data on the elevated blood-lead levels in children is discussed in the Madison County Health Department Activities section of this document. After finding elevated lead levels in fill material at the Madison County Farm Supply and children with elevated blood-lead levels living nearby, EPA conducted a removal assessment in the city of Fredericktown. The assessment identified yards with lead levels above 1,200 ppm, and driveways that could be potentially constructed of mine waste. Based on these findings, EPA began a time-critical removal action to further investigate how many private yards had lead contamination and remediate as appropriate (11,12).

By the end of year 2004, 1,890 properties had been screened for lead contamination. Excavation of the lead-contaminated soil and/or tailings exceeding 1,200 ppm or having an elevated blood-lead child living at the residence has been conducted on approximately 475 properties (including one elementary school, two daycares, and two trailer parks). The contaminated yard soil was replaced with clean soil having less than 240 ppm lead. Driveways with lead-contaminated tailings were replaced with crushed limestone. Approximately 100 yards remained to be excavated as of the end of 2004, but requests for screening continue to come in (13). Of the yards excavated, the maximum level of lead detected was 24,900 ppm, but the majority ranged between the high 1,000s to the low 3,000s (14). Although the exposure pathways of ingestion and inhalation will be eliminated in remediated yards, two groups of properties remain to be addressed: the residential yards where access to sample or remediate was not granted; and those yards where the level of lead contamination falls above the acceptable level of 400 ppm, but below the removal level of 1,200 ppm of lead. The yards not remediated under the time-critical removal action and yards with lead levels between 400 ppm and 1,200 ppm are to be addressed later under the OU-3 remedial action after the time-critical removal action is completed (conversation with EPA's On-Site Coordinator and EPA's Remedial Project Manager).

Other Investigations and Areas

In August and September of 2002, EPA collected soil, surface water, sediment, and residential yard samples to better characterize the Fredericktown/Anschutz watershed drainage area. The samples were screened for up to 23 metals. Some of the samples exceeded health guidelines or EPA drinking water standards. Lead was found in residential soils above health guidelines at a maximum of 10,000 ppm. Other metals did not exceed health guidelines or were borderline in samples from residential yards (15,16). See Table 2 for a summary of contaminants, their range of detection, and screening value. Further investigation of the watershed area is expected.

Private Property Northeast of the Mine La Motte tailings

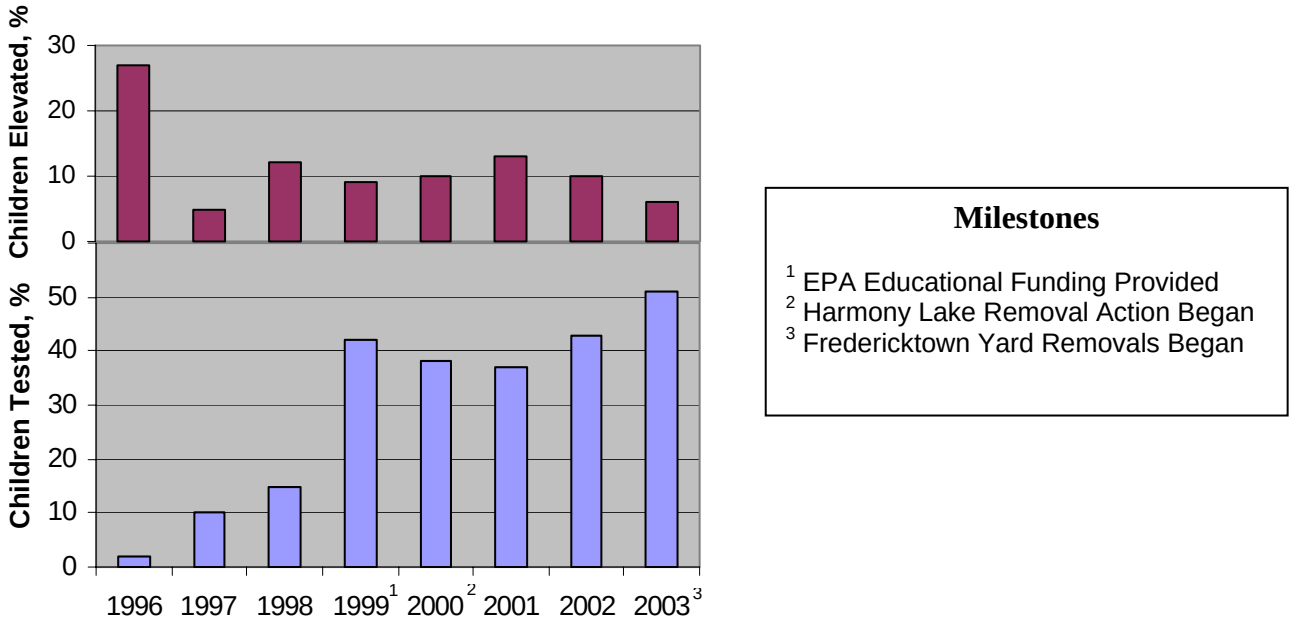
The private property northeast of the Mine La Motte tailings was also sampled as part of OU-1. Presently the property is not included under any OU. The property appears to have been an old lead processing facility that still has portions of the original buildings and equipment in place. The old processing facility has the original chain link fence, preventing access to the private property. The property is currently used for a sawmill operation, but the owner also has beef cattle on the property. Levels of lead on the property varied from 20,100 to 67,400 ppm in the four surface soil samples taken on the property. Arsenic levels ranged from 16 to 66 ppm in the same four samples (1,4). Reportedly, cattle are kept on the area of lead contamination including the area with the maximum lead concentration. The cattle may be in the area for up to a maximum of six months and graze on the grass when available, but are also fed hay and cattle feed.

Madison County Health Department Activities

Prior to the Madison County Mines site being listed as a National Priority List site, elevated blood-lead levels were known to be a problem in Madison County. DHSS data show that the Madison County Health Department (MCHD) tested 2% (22 children) of an estimated population of 900 children less than six years of age in 1996, of which 27% (6 children) of those tested were found to have blood-lead levels above 10 microgram per deciliter (μg/dL). This data was obtained from the DHSS Systematic Tracking of Elevated Lead Levels and Remediation (STELLAR) program. EPA investigations had detected lead contamination in the tailings in Madison County that were similar to those in St. Francois County. The 1998 ATSDR/DHSS Big River Mine Tailings Superfund Site Lead Exposure Study in St. Francois County found that 17% of the children living in tailings areas had elevated blood-lead levels compared to 3% in the control area. Because of this data and the similarity of the tailings problem in the two counties, EPA was able to provide funds to DHSS to conduct health activities. DHSS contracted with MCHD to expand their blood-lead testing program, provide health education, and reach more of the affected population of Madison County. EPA has provided funding to continue these actions since 1999. According to DHSS data, MCHD has been able to increase testing to 51% (428 children from a population of 835) of children less than six years of age living in Madison County in 2003. Of the 51% of children tested, 6% (26 children) still have elevated blood-lead levels. Percentages of children tested and the percentage of those tested with elevated blood lead

levels less than six years of age for calendar year 1996 through 2003 is illustrated in the following figure:

Percentages of Children Tested and with Elevated Blood Lead Levels
Madison County Superfund Site



Source: Missouri Department of Health and Senior Services Systematic Tracking of Elevated Lead Levels and Remediation (STELLAR) 1996-2003.

Besides the expanded blood-lead testing, MCHD has implemented an aggressive health education campaign that includes providing cleaning materials for those using the Lake La Motte recreation area. This is an area where exposure is likely to occur because most of the camping and recreation area is located on tailings. Because of the MCHD intervention, campers are made aware of the health hazards of the lead contaminated tailings. Also, the provided cleaning materials will lower their exposure to the tailings if used to clean their environment and proper personal hygiene is practiced. The MCHD also conducts the monthly Madison County Environmental Roundtable meetings. The meetings include the involved agencies and is set up to inform the public of current activities, provide a public forum for discussion, and provide health education to the public.

Land Use, Natural Resources, and Geology

The Madison County Mines site consists mostly of the remnants of past mining activities located in certain areas around the city of Fredericktown. Outside the city of Fredericktown and around

the different tailings areas, the area is diversified with wooded areas, pastureland, farming, and single-family housing on large-sized lots or farmsteads.

The Madison County Mines site is located on the eastern edge of the Ozark uplift within the St. Francois Mountains. This area is underlain by marine sediments from the late Cambrian to Eocene age, which consist of sandstone, limestone, and shale. La Motte sandstone overlies the Pre-Cambrian basement deposits and may be as thick as 200 feet in the site area. Overlying the La Motte sandstone are the Bonneterre, Davis, and Derby-Doerun Formations and unconsolidated overburden. The Bonneterre Formation is generally 400 feet thick, but can be as thick as 1,500 feet. It is comprised of sandstone and dolomite and is the source of much of the lead that has been mined in Missouri. While karst features are naturally present in the areas of mining, the underground mine workings have also resulted in the collapse of overlying materials and in the formation of sinkholes at the ground surface (2).

Groundwater flow within the site area is poorly defined due to karst conditions and mining. Under natural conditions, the flow is expected to follow topographic gradients toward the St. Francois River (2). There is a rural water district, but it only covers limited areas. Rural residents outside of the rural water district must install private wells. Private wells located near underground mining operations could be affected by the contaminated mine water.

Surface water in the area ultimately flows into the St. Francois River. The tailings areas located to the north of Fredericktown (with the exception of Mine La Motte) drain into the Little St. Francois River above City Lake. The city of Fredericktown uses water from City Lake for their water supply.

Physical Hazards

Physical hazards at the Madison County Mines site vary at each tailings area. Depending on the tailings area, physical hazards may include protrusions from the tailings (wood and metal objects), steep slopes or drop-offs, old mechanical equipment, open or abandoned mine shafts, open drainage structures, and open-air shafts. Only at the Harmony Lake Tailings area and the Catherine Mine Tailings area have recent efforts been made to eliminate the physical hazards. In some tailings areas, tailings have badly eroded and pose the problem of further washouts and collapses (personal observation during site visits). An open-air shaft with an improper cover was found near a residence during an investigation of soil lead levels. Other similar hazards may be present around the different mined areas (personal conversation with EPA on-site coordinator).

Demographics

The Fredericktown zip code (63645) was used to determine the population potentially affected by the tailings areas. For the year 2003, the zip code included a population of 10,981, with 98.4% white, 0.1% black, 0.2% American Indian, 0.3% Asian or Pacific Islander, and 1.0% being of other race or two or more races (17). In 2000, there were 613 children under the age of five years old and 500 individuals of age 65 years and older. The median household income was

$26,014 for the year 2000, with 12.3 % of the population living below the poverty level (18). In general, the residents considered under the zip code represent a predominantly white, working-class community in a semi-rural area of Madison County.

Quality Assurance and Quality Control

Various people, organizations, and contractors have been involved in the sampling, research, and analyses at this site, resulting in Quality Assurance and Quality Control (QA/QC) information of varying degrees of accuracy and precision.

In preparing this public health assessment, DHSS and ATSDR have relied on the information provided in the referenced documents and have assumed that adequate quality assurance and quality control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting. The validity of the analysis and, therefore, the conclusions in this public health assessment are valid only if the referenced information is complete and reliable.

DISCUSSION

Pathways Analysis

This section addresses the pathways by which residents of the area may have been exposed to lead from the contaminated tailings. When a chemical is released into the environment, the release does not always lead to exposure. Exposure only occurs when a chemical comes into contact with and enters the body. To determine whether the residents of Madison County, particularly those living in the vicinity of tailings areas and in areas where tailings were hauled to were exposed, DHSS conducted an analysis of exposure pathways. For a chemical to pose a health risk, a completed exposure pathway must exist. ATSDR has determined that an exposure pathway consists of five elements including: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways require that all five of the elements of exposure exist. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. Potential exposure pathways, however, have at least one of the five elements missing or uncertain, but could exist. Completed and potential exposure pathways could have occurred in the past, could be occurring presently, or could occur in the future. Because the physical and chemical composition of contaminants is similar in all of the OUs, pathways of human exposure in each of the OUs are the same. Exposure is through the ingestion or inhalation of lead-contaminated tailings that have been placed on the land surface or moved where human can come into contact with them.

Completed Exposure Pathways

Lead has been found to be the main contaminant at the Madison County Mines site and has contributed to elevated blood-lead levels in children less than six years of age. The five elements of a completed exposure pathway at the Madison County Mines site are:

1. **Contaminant source –** lead contaminated tailings.
2. **Environmental medium and transport** – soil, sediment, air, dust, water, fish, garden vegetables, and groundwater.
3. **Point of exposure** – areas where exposure to lead contamination is taking place.
4. **Route of exposure** – ingestion and inhalation.
5. **Receptor population** – those that ingest and/or inhale lead contamination.

Table 3 in Appendix B illustrates the different exposure pathways present at the Madison County Mines site.

Completed Exposure Pathways

Completed exposure pathways of inhalation and ingestion existed in the past, are presently occurring, and will continue in the future, especially for children, until the pathways to the lead-contaminated tailings are lessened or eliminated. Lead is the primary contaminant of concern and completed exposure pathways exist in all OUs. Residential exposure to contaminated yards, driveways and indoor dust occurs in OU3 and the Fredericktown Time-Critical Removal Area. Recreational exposure to tailings occurs on a more or less frequent basis at all OUs. Young children are more likely to be exposed to lead contamination, because they are in greater contact with the lead-contaminated dust and soils in their environment and have a greater hand-to-mouth activity. In 2003, six percent of children tested in the county still have elevated blood-lead levels above 10 μg/dL.

Potential Exposure Pathways

Potential exposure pathways may exist for those who contact and use the streams and lakes that may have contaminated sediment, water, and fish. To date, lead has been found to be the primary contaminant of concern associated with the tailings. Although other metals have been detected in certain portions of this site, insufficient data exists for sediment, surface water, and fish to determine if they pose a hazard. It is known that tailings from the northern tailings piles (OU-1), have washed into the streams draining them and that a maximum lead level in sediment of 7,610 ppm was found in 1999. In the other OUs, sampling data to determine what contamination levels may be present is dated, limited, or non-existent. Fish were sampled in OU-1 as part of the 1999 sampling event, but did not include adequate sampling of bottom-feeding fish.

Sampling in 2002 of the Fredericktown/Anschutz (OU2) watershed drainage found elevated levels of metals in the water and sediment. Access to these areas is unrestricted (except for some areas being private property) allowing for the potential for exposure to these contaminants.

One private well is known to be open to the underground mine works and has shown elevated levels of cobalt, manganese, and nickel, but the water is not used for drinking. It is not known how many other private wells may be affected by the mine workings.

Another potential pathway of concern is ingesting vegetables grown in lead contaminated soil at any of the OUs. The main concern is root crops that are not completely washed before eating, but one aboveground crop (lettuce) can uptake some lead from the soil.

The private property northeast of the Mine La Motte tailings has the highest level of lead in the area at 67,400 ppm. The property is presently used as a sawmill operation and part-time cattle grazing. Although there is not expected to be much exposure to the contaminated soil under the site's present use, future use of the site is unpredictable, and could lead to human exposure to site contaminants. Cattle grazing on the contaminated area for part of the year are not expected to be affected or store lead in tissue (meat) that could affect humans.

TOXICOLOGICAL EVALUATION

Introduction

This section will discuss the health effects of exposure to specific contaminants found at the site. A discussion of non-cancerous health effects and the possibility of the contaminants causing cancer are evaluated in this section. ATSDR has developed Comparison Values (CV) that is media-specific concentrations used by health assessors to select environmental contaminants of concern. Contaminant concentrations that are less than the CV are unlikely to pose a health threat. Contamination levels above the CV do not necessarily indicate that a health threat is present, but that further evaluation of the chemical and pathways is needed. CVs are usually developed for chronic (more than 365 days) exposure, intermediate (14 day to 365 days) exposure and acute (less than 14 days) exposure. Environmental Media Evaluation Guides (EMEGs) are CVs that have been derived for a variety of chemicals in various media. ATSDR has not developed a CV for lead, but one is available for arsenic.

Lead, and to a lesser extent arsenic, have been found in tailings piles that are located around the city of Fredericktown. The tailings areas and residential yards vary as to the amount of exposure that occurs in each area. Although lead is naturally occurring, the practice of depositing mine tailings above ground has made a large volume of lead more accessible to people. From natural processes and human intervention, the contaminated tailings have moved throughout the community in different media where exposure, especially for children, has occurred. Lead can also be a problem in older homes where lead paint was used.

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 paint (19). Paint containing lead may still be present in older homes and becomes more available for uptake into the body, especially for children, if it is deteriorated or flaking. Tailings contaminated with lead have been deposited on the ground surface in tailings piles and also moved by natural and man into areas where exposure can easily occur.

The pathways of concern for lead exposure are inhalation and ingestion. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure. Although the major tailings piles are some distance from the main community of Fredericktown, the lead-contaminated tailings have been transported by humans and used for driveways and fill. Residential driveways and yards have been found with lead contamination up to a maximum of 24,900 ppm. Exposure to lead in the tailings piles may occur in all OUs. While many of the piles are in remote locations where exposure is unlikely, others, such as the Mine La Motte tailing pile, are used recreationally. Recreational activities at the Mine La Motte may include a few hours of hiking or ATV riding to several weeks of on-site camping and recreation.

The correlation between lead-contaminated soil and blood lead level continues to be a challenge. Correlations cited in the literature are influenced in specific studies by many factors, including access to soil, behavior patterns (especially of children) presence of ground cover, seasonal variation of exposure conditions, particle size and composition of lead compounds found at various sites and the exposure pathway. These complex factors explain in some instances discrepant findings that are reported in the literature (20).

The biologic fate of inorganic lead in the human body is well known. Inorganic lead is not metabolized but is directly absorbed, disturbed, and excreted. Once in the blood, lead is disturbed primarily among three compartments—blood, soft tissue (kidney, bone marrow, liver, and brain), and mineralizing tissue (bones and teeth). Mineralizing tissue contains about 95% of the total body burden of lead in adults (20).

Children are more sensitive to the effects of lead than adults. Few studies are available that indicate how much lead in soil and dust may result in an increase of blood-lead levels when lead is ingested or inhaled. The Centers for Disease Control and Prevention (CDC) considers lead poisoning the number one preventable pediatric health problem facing children. Several signs of lead toxicity have been described at the low levels of exposure that are comparable to those found near these sites. They include decreased attention span, hyperactivity, and lower IQ scores. Blood-lead levels as low as 10 μg/dL have been shown to affect child development. Needleman and Gatsonis report that children's IQ scores are inversely related to blood lead levels. Several studies provide sufficient evidence that children's mental process or the faculty by which knowledge is acquired was adversely affected by lead (19).

For children, the predicated 95th percentile blood lead level associated with a soil lead concentration of 340 ppm is approximately 10 μg/dL (21). Therefore, children who are regularly exposed to soil lead levels of 340 ppm should have no more than a 5% probability of having blood lead levels greater than 10 μg/dL (21). Residential yards and the tailings areas at the Madison County Lead site have been found to contain lead levels exceeding 340 ppm.

A fetus can also be exposed to lead through their mothers and can have problems such as premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (19).

Arsenic

Arsenic is an element that is widely distributed in the earth's crust. Inorganic arsenic occurs naturally in soils and many kinds of rock, especially in minerals and ores that contain copper and lead. Arsenic cannot be destroyed in the environment, but can only change it form, or become attached or separated, from particles. It may change its form by reacting with oxygen or other molecules present in air, water, or soil, or by the action of bacteria that live in soil or sediment (22).

The pathways of uptake for arsenic are ingestion and inhalation. Arsenic contaminated soil or water on the skin is a minor pathway, and is not usually a concern. After exposure to arsenic, the liver changes some of this to a less harmful organic form, which is excreted in the urine. Most of the arsenic will be gone within several days, but some will remain in the body for several months or longer. Inorganic arsenic has been recognized as a human poison since ancient times, and large oral doses (above 60 ppm in food or water) can produce death. Smaller doses of inorganic arsenic (0.3 to 30 ppm in food or water), may cause irritation of your stomach and intestines, with symptoms such as stomach ache, nausea, vomiting, and diarrhea. Other effects from ingestion of inorganic arsenic include decreased production of red and white blood cells which may cause fatigue, abnormal heart rhythm, blood-vessel damage resulting I bruising, and impaired nerve function causing a "pins and needle" sensation in the hands and feet (22).

Arsenic was detected in the tailings of the OU-1 area ranging from 1 ppm to a maximum of 238 ppm in 1999, above the ATSDR's EMEG for soil of 20 ppm for children and 200 ppm for adults for chronic exposure. Sampling of yards in Fredericktown in 2002 did not find arsenic levels above the EMEG. Therefore, from available data, it does not appear that residential exposure is taking place above the EMEG and at a level of health concern. The potential does exist that a person could be exposed to the higher levels of arsenic in the tailings enough to cause health effects, but is not likely. Planned investigations of the OUs will provide more information into the areas where elevated arsenic is present and the possibility of exposure above a level of health concern exists.

Cancer

The American Cancer Society estimates that in the United States, slightly less than half of all men and slightly more than one-third of all women will develop some form of cancer in their lifetime (23). Although lead is considered a B2 carcinogenic (probable human carcinogen, inadequate human, sufficient animal studies) by EPA, no studies in humans were found to indicate that inorganic lead was carcinogenic to humans after inhalation or ingestion exposure (19). The National Toxicology Program (NTP) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens based on limited evidence from studies in humans and sufficient evidence from studies in experimental animals (24).

Arsenic is considered by EPA, the International Agency for Research on Cancer, and the National Toxicology Program to be a human carcinogen by the inhalation and ingestion exposure routes. Exposure by the inhalation route in workers has shown the predominant carcinogenic effect is increased risk of lung cancer. In general, most researchers observe that risk increases as a function of exposure and duration. Most of the research on arsenic causing lung cancer comes from studies involving workers at copper smelters and arsenical chemical plants. When exposure occurs by the ingestion route, the main carcinogenic effect is increased risk of skin cancer. This is based on epidemiological studies of populations exposed to levels of arsenic in drinking water. Other studies have shown that inorganic arsenic can also increase the risk of bladder, liver, kidney, and prostate cancer (22). ATSDR has developed a Cancer Risk Evaluation Guide (CREG) for arsenic. Levels below the CREG value are not expected to cause a cancer rate above an additional cancer per 1,000,000 persons. The CREG value for arsenic in soil is 0.5 ppm and arsenic in air of 0.0002 micro grams per cubic meter ($\mu g/m^3$). If residents of Madison County were exposed to arsenic in soils or air at levels above the CREG value for a lifetime, additional cancers would be a possibility. Considering the variation of arsenic levels in the soil/tailings, the intermittent and short-term exposure to the tailings and that air concentrations for arsenic are not known, it cannot be determined if arsenic in the tailings poses a health concern for cancer.

Child Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are more vulnerable to lead poisoning than adults and are more likely to be exposed to lead contaminated materials because their activities involve introducing non-food items into their mouths. They can also be exposed to lead in the womb if their mothers have lead in their bodies. Babies and children can swallow and breathe lead in dirt, dust, or sand while they play on the floor or ground. The dirt or dust on their hands, toys, and other items may have lead particles in it.

Compared to adults, a bigger proportion of the amount of lead swallowed will enter the blood in children. While about 99% of the amount of lead taken into the body of an adult will leave as

waste within two weeks, only about 32% of lead taken into the body of a child will leave as waste. This allows for the accumulation of lead in the child's system. When children are exposed to the 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 (19).

Unborn children who are exposed to lead through their mothers can have problems such as premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (19).

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, good personal hygiene, and a proper diet can prevent lead poisoning in children. To determine if a child has been exposed, blood-lead testing is available at the Madison County Health Department. The emphasis of blood-lead testing is for children six years old and younger who are the most susceptible to blood-lead poisoning. The health department also provides lead educational materials for parents and their children to help them eliminate exposure pathways, promote good personal hygiene, and maintain a healthy diet. If these recommendations are followed, a parent could greatly reduce their child's chance of becoming lead poisoned.

Children visiting the Mine La Motte Recreation Area need to be especially careful to avoid playing in lead-contaminated areas. This is difficult, as the playground and other areas are contaminated with lead. The Madison County Health Department is providing health educational materials as well as cleaning materials to help visitors lessen or eliminate exposure pathways. To help limit ingestion of lead-contaminated soils, parents are encouraged to insist that children wash their hands and face before eating or drinking. Proper hygiene will lessen, if not eliminate exposures to lead at these sites. Parents are also encouraged to have their children's blood lead level tested.

COMMUNITY HEALTH CONCERNS

To involve the public and answer their concerns, the Madison County Environmental Roundtable was formed in 1999. The roundtable has held quarterly or monthly meetings where citizens can come and hear what activities are taking place at the sites, as well as express their concerns to the different agencies. The Madison County Health Department (MCHD), EPA, MDNR, DHSS, and ATSDR have attended roundtable meetings since its inception. MCHD has also provided informational messages to the public in the form of tabletop advertisements in restaurants, newspaper ads and announcements, radio spots, and distributed pamphlets to day-care centers and schools. Despite this information, the public has expressed little health concern about the tailings piles in the area. Concern was raised from citizens about their private wells when some of the wells and boreholes to the mines became artesian. When the remediation of private yards began occurring in Fredericktown, residents did not seem overly concerned, but the majority did allow their yards to be screened for lead contamination.

On April 26, 2005, DHSS held a public availability session to present the public comment version of the Madison County Mines Site Public Health Assessment to the public and to gather and discuss any additional concerns the public might have. No health concerns were presented in person at the public availability session or received in the mail. Some technical comments were received from EPA during the public comment period and the text has been revised accordingly.

CONCLUSIONS

Because of past mining activities that have placed lead-contaminated tailings/chat material in the environment where humans have been exposed in the past, present, and will continue to be exposed in the future, the Madison County Mines Site is considered a public health hazard for the past, present, and future. The category of a public health hazard is assigned to sites that pose a public health hazard as the result of long-term exposures to hazardous substances. This classification is based on the following considerations:

1. Exposure is occurring to lead contamination in residential yards, driveways, tailings piles, and areas where tailings have eroded or been moved to.

2. It is not known if private wells in the area are being affected by past mining activities.

3. A complete investigation of possible areas of contamination and pathways of exposure has not been completed for all areas.

4. Physical hazards such as drop-offs and wood or metal protrusions remain at some of the tailings areas. Also, old airshafts and exploratory holes may be present at private residences from past mining activities.

5. A former lead processing facility associated with the Mine La Motte tailings site has the highest concentration of lead in the area and exposure could occur in the future if usage of the property changes.

6. Tailings have been used for a variety of purposes where residents and especially children can be easily exposed.

RECOMMENDATIONS

1. EPA should continue to investigate residential yards and other areas where children might be exposed to elevated lead or other metals contamination and remediate appropriately.

2. EPA should identify and sample private wells in the area to determine if past mining activities have affected them.

3. EPA should continue with their plan to investigate the tailings piles, their associated areas, and other suspected areas for lead, heavy metals, and other contaminants; and remediate as appropriate to eliminate exposure pathways.

4. EPA should eliminate physical hazards from past mining activities as appropriate or restrict access.

5. EPA should consider further investigation and remediation of the lead processing area associated with the Mine La Motte tailings area.

6. Citizens, contractors, and others should only use the mine waste (tailings) in ways not likely to affect human health. EPA's February 2003 Fact Sheet on Mine Waste should be used as guidance and unacceptable uses of tailings should be discouraged (See Appendix D).

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for the Madison County Mines Site contains a description of 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 assessment 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. EPA is negotiating with the PRPs to do further investigations of OU-1 and OU-2 and will conduct an investigation and necessary remedial actions at OU-3.

2. DHSS/ATSDR will review additional sampling data from further investigations of the different Operable Units and provide guidance regarding possible health risk.

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

4. DHSS/ATSDR will coordinate with MDNR/EPA to implement the recommendations in this public health assessment to eliminate or lessen exposure in the community.

5. DHSS/ATSDR will update this public health assessment as more information becomes available.

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CERTIFICATION

This Madison County Mines Site Public Health Assessment was prepared by the Missouri Department of Health and Senior Services, under a cooperative agreement with the federal Agency for Toxic Substances and Disease Substances (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the public health assessment 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 public health assessment and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR

APPENDIXES

Appendix A:

Figure 1: Site Location Map
Figure 2: Before and After Photos of Harmony Lake Tailings Remediation

Appendix B:

Table 1: Summary of Contaminants at Madison County Mines OU-1 and Health Guidelines
Table 2: Summary of Contaminants from Other Investigations and Areas
Table 3: Madison County Mines Site Exposure Pathways

Appendix C:

Glossary of Terms and Acronyms List

Appendix D:

EPA Fact Sheet on Mine Waste

Appendix A

Figures: Figure 1: Site Location Map
Figure 2: Before and After Photos of Harmony Lake Tailings Remediation

Figure 1

Madison County Mines Site Location Map

Note: Only the major tailings areas are shown on this map, other tailings areas may exist.

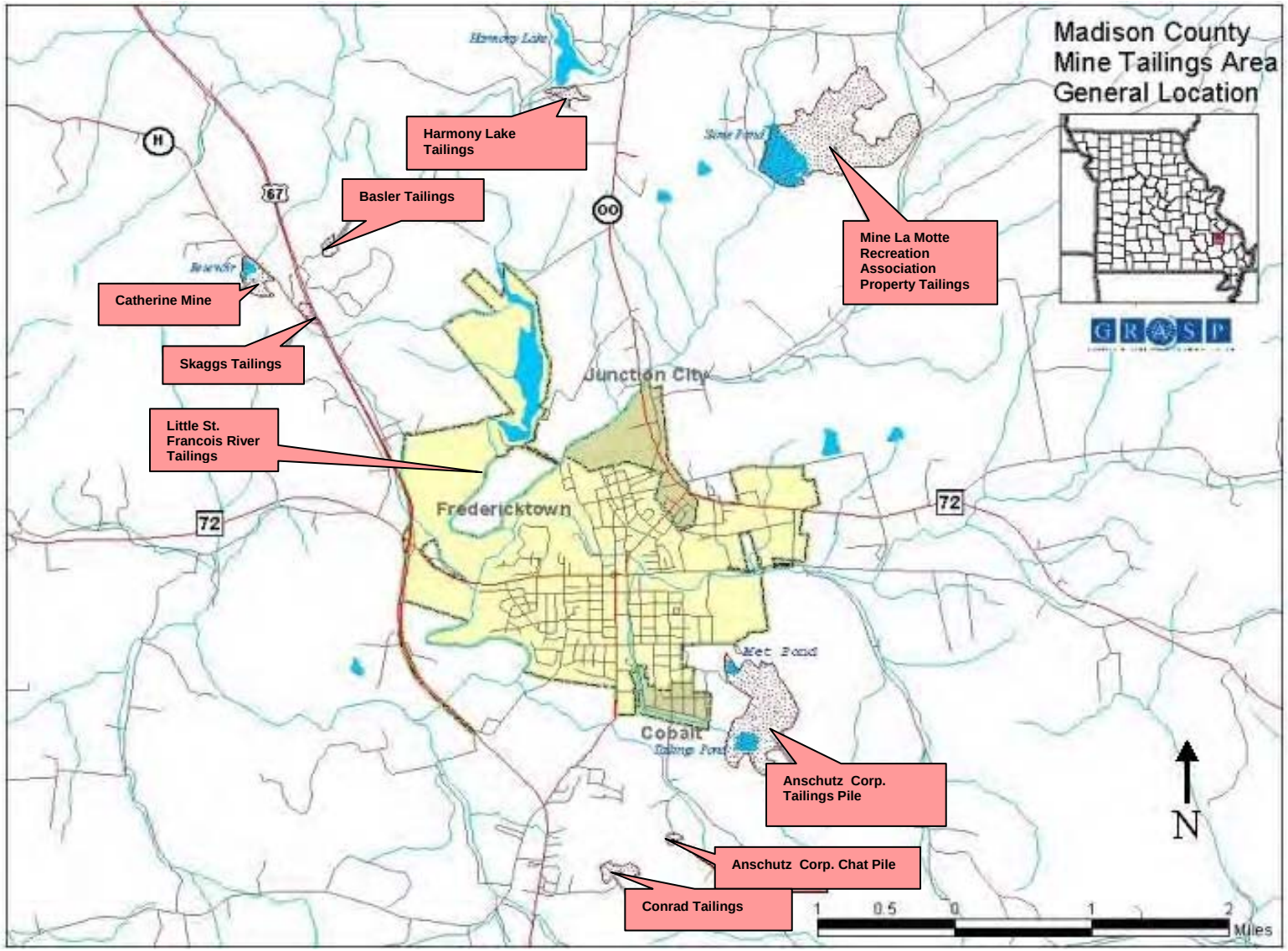

Figure 2
Harmony Lake Tailings Site - Before (1998) and After (2001) Remediation

1998

2001

Appendix B

Table 1: Summary of Contaminants at Madison County Mines OU-1 and Health Guidelines
Table 2: Summary of Contaminants from Other Investigations and Areas
Table 3: Madison County Mines Site Exposure Pathways

Table 1
Summary of Contaminants at Madison County Mines OU-1 and Health Guidelines
Levels are in parts-per-million (ppm) unless otherwise noted (1,4,5)

Contaminant	Location	Media	Range	Screening Value & Source
Lead	Tailings Piles	Tailings	257 – 10,200*	260 MO. CALM
Lead	Transect Soils	Soil	0.6 – 24,400	260 MO. CALM
Lead	Camping Areas	Tailings	710 - 986	260 MO. CALM
Lead	Playground (MLMRA)	Tailings	1,130	260 MO. CALM
Lead	Sediment	Sediment	677 – 9,920	260 MO. CALM
Lead	Surface Water	Water	ND – 206 ppb	15 ppb EPA PDWS
Lead	Residential Yards (HLA)	Soil	166 – 19,100	260 MO. CALM
Lead	Drinking Water Wells	Water	ND – 26 ppb	15 ppb EPA PDWS
Lead	Surface Soils (OJM)	Soil	19,100 – 22,000	260 MO. CALM
Lead	Surface Water (Lakes)	Fish Filets	4 – 62 ppb	200 ppb WHO (filets)
Arsenic	Tailing Pile	Tailings	14 – 238	20 ATSDR EMEG - child
Arsenic	Transect Soils	Soils	1 – 32	20 ATSDR EMEG - child
Arsenic	Playground (MLMRA)	Tailings	14	20 ATSDR EMEG - child
Arsenic	Sediment (MLMRA)	Tailings	46 – 144	20 ATSDR EMEG - child
Arsenic	Residential Soils	Soil	3 – 33	20 ATSDR EMEG - child
Arsenic	Surface Soils (OJM)	Soil	23 – 96	20 ATSDR EMEG - child

ppb = parts per billion
MLMRA = Mine La Motte Recreation Area
OJM = Old Jack Mine area
EPA PDWS = Environmental Protection Agency Public Drinking Water Supply Action level
EMEG = Environmental Media Evaluation Guide (ATSDR)
WHO = World Health Organization
MO. CALM = Cleanup Levels for Missouri for "Unrestricted" land use including residential
* Harmony Lake Area Tailings had a maximum lead level of 35,000 ppm but the area has been remediated
ND = Not Detected
HLA = Harmony Lake Area residential yards

Table 2

Summary of Contaminants from Other Investigations and Areas
Madison County Mine Site

All levels in parts per million (ppm)

Surface Water		
Contaminant	**Range**	**Screening Value and Source**
Iron	0.037 – 4.5	0.3 EPA SDWR
Lead	0.0057 – 0.15	0.015 EPA PDWS
Manganese	0.024 – 7.6	0.5 ATSDR RMEG – child
Nickel	0.01 – 0.78	0.2 ATSDR RMEG – child
Silver	0.1	0.05 ATSDR RMEG – child
Sediment		
Arsenic	0.85 – 59	20 ATSDR EMEG – child – chronic
Lead*	52 – 1,900	260 MO. CALM
Soil		
Arsenic*	3.4 – 74	20 ATSDR EMEG – child – chronic
Lead*	67 – 10,000	260 MO. CALM
Manganese*	2,200 – 5,400	3,000 ATSDR RMEG – child
Thallium*	ND – 0.41[±]	0.005 ATSDR RMEG - child

EPA SDWR = Environmental Protection Agency Secondary Drinking Water Regulation
EPA PDWS = Environmental Protection Agency Public Drinking Water Supply Action level
RMEG = Reference Dose Media Evaluation Guide (ATSDR)
EMEG = Environmental Media Evaluation Guide (ATSDR)
MO. CALM = Cleanup Levels for Missouri for "Unrestricted" land use including residential
* Sampling results contained a number of qualifiers for different samples, questioning their accuracy. Those results with qualifiers were not used.
[±] Elevated levels were not detected in residential yards

TABLE 3

Madison County Mines Site Exposure Pathways

Pathways Name	Exposure Pathways Elements						Type of Pathway
	Source	Environmental Media	Point of Exposure	Route of Exposure	Receptor Population	Time	
Soil	Tailings	Soil	Driveways, Private Yards and Tailings Areas	Ingestion and Inhalation	Area Residents and Campers	Past, Present, and Future	Completed
Ambient Air	Tailings	Air	Local Ambient Air	Inhalation	Area Residents and Campers	Past, Present, and Future	Completed
Indoor Dust	Tailings	Indoor Air and Dust	Inside Homes	Inhalation and Ingestion	Area Residents	Past, Present, and Future	Completed
Groundwater	Underground Mined Areas	Groundwater	Private Wells	Ingestion	Private Well Users	Past, Present, and Future	Potential
Sediment	Tailings	Sediment	Tailings Area, Streams, and Lakes	Ingestion	Residents Around Tailings, Streams and Lakes	Past, Present, and Future	Potential
Surface Water	Tailings	Surface Water	Area Streams and Lakes	Ingestion	Stream and Lake Users	Past, Present, and Future	Potential
Fish	Tailings	Fish	Food Consumption	Ingestion	Fish Eaters of Local Fish	Past, Present, and Future	Potential
Garden Vegetables	Tailings	Garden Vegetables	Food Consumption	Ingestion	Garden Vegetable Eaters	Past, Present, and Future	Potential

Appendix C

Glossary of Terms and Acronyms

Glossary of Terms and Acronyms

General Terms

Absorption The process of taking in, as when a sponge takes up water. Chemicals can be absorbed through the skin into the bloodstream and then transported to other organs. Chemicals can also be absorbed into the bloodstream after breathing or swallowing.

Acute Occurring over a short time, usually a few minutes or hours. An *acute* exposure can result in short-term or long-term health effects. An *acute* effect happens a short time (up to 1 year) after exposure.

Additive Effect The response to a chemical mixture, or combination of substances, that might be expected if the known effects of individual chemicals at specific doses, were added together.

Adverse Health Effect A change in body function or the structures of cells that can lead to disease or health problems.

Antagonistic Effect A response to a mixture of chemicals or a combination of substances that is less than might be expected if the known effects of individual chemicals at specific doses were added together.

Ambient Surrounding. For example, *ambient* air is usually outdoor air (as opposed to indoor air).

Analyte A chemical component of a sample to be determined or measured. For example, if the *analyte* is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic Epidemiologic Study Investigations designed to evaluate the causal nature of associations between exposure to hazardous substances and disease outcome by testing scientific hypotheses.

Applied Research An investigative study in which the results are used in actual practice.

ATSDR The Agency for Toxic Substances and Disease Registry. ATSDR is a federal health agency located in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.

Background Level A typical or average level of a chemical in the environment. *Background* often refers to naturally occurring or uncontaminated levels.

Biological Indicators of Exposure Study A study designed to use biomedical testing or the measurement of a chemical (analyte), its metabolite, or another marker of exposure in human body fluids or tissues in order to validate human exposure to a hazardous substance.

Biological Monitoring Measuring chemicals in biological materials (blood, urine, breath, etc.) to determine whether chemical exposure in humans, animals, or plants has occurred.

Biological Uptake The transfer of hazardous substances from the environment to plants, animals, and humans. This may be evaluated through environmental measurements, such as measurement of the amount of the substance in an organ known to be susceptible to that substance. More commonly, biological dose measurements are used to determine whether exposure has occurred. The presence of a contaminant, or its metabolite, in human biologic specimens, such as blood, hair, or urine, is used to confirm exposure and can be an independent variable in evaluating the relationship between the exposure and any observed adverse health effects.

Biomedical Testing Biological testing of persons to evaluate a qualitative or quantitative change in a physiologic function that may be predictive of a health impairment resulting from exposure to hazardous substance(s).

Biota As used in public health, things that humans would eat – including animals, fish and plants.

Body Burden The total amount of a chemical in the body. Some chemicals build up in the body because they are stored in fat or bone or are eliminated very slowly.

Cancer A group of diseases that occur when cells in the body become abnormal and grow, or multiply, out of control.

Carcinogen Any substance that may produce cancer.

CAS Number (also **CAS Registry Number**, **CAS RN**, or **CAS#**) A unique accession number assigned by the Chemical Abstracts Service, a division of the American Chemical Society. Other than being guaranteed unique to a given compound, this number has no particular meaning. CAS Registry Numbers are assigned to every uniquely-identifiable substance, so 'cis-2-hexene', 'trans-2-hexene', and '2-hexene' (a mixture with unspecified cis/trans composition) are all assigned separate CAS Numbers.

Case Study The medical or epidemiologic evaluation of a single person or a small number of individuals to determine descriptive information about their health status or potential for exposure through interview or biomedical testing.

Central Nervous System The part of the nervous system that includes the brain and the spinal cord.

CERCLA The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund. CERCLA was enacted in 1980. It is also known as Superfund. This act concerns the release of hazardous substances into the environment and the cleanup of these substances and hazardous waste sites. This is the legislation that created ATSDR.

Chronic Occurring over a long period of time (more than 1 year).

Cluster Investigation A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. *Cluster investigations* are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and environmental factors.

Community Assistance Panel (CAP) *Community assistance panels* are established to (1) facilitate constructive communication between ATSDR and the affected community; (2) provide an ongoing series of community-based meetings to ensure community involvement throughout the range of ATSDR public health activities at a site; and (3) provide information to ATSDR on the community's health concerns for inclusion in the public health assessment.

Community Health Investigation Medical or epidemiologic evaluation of descriptive health information about individual persons or a population of persons to evaluate and determine health concerns and to assess the likelihood that they may be linked to exposure to hazardous substances.

Comparison Values Estimated contaminant concentrations in specific media that are not likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. The *comparison values* are calculated from the scientific literature available on exposure and health effects.

Concern The belief or worry that chemicals in the environment might cause harm to people.

Concentration The amount of a substance present in soil, water, air or food.

Contaminant Any substance or material that enters a system (the environment, human body, food, etc.) where it is not normally found.

Delayed Health Effect A disease or injury that happens as a result of exposures that may have occurred far in the past.

Dermal Referring to the skin. *Dermal* absorption means absorption through the skin.

Descriptive Epidemiology Study of the amount and distribution of disease within a population by person, place, and time.

Disease- and Symptom-Prevalence Study A study designed to measure the occurrence of self-reported disease that may, in some instances, be validated through medical records or physical examination if available, and to determine those adverse health conditions that may require further investigation because they are considered to have been reported at an excess rate. This study design can only be considered hypothesis generating.

Disease Registry A system for collecting and maintaining in a structured record, information on persons having a common illness or adverse health condition.

Dose The amount of substance to which a person is exposed. *Dose* often takes body weight into account.

Dose/Response The relationship between the amount of exposure (dose) and the change in body function or health that results.

Duration The period of time (days, months, years) that a person is exposed to a chemical.

Environmental Contamination The presence of hazardous substances in the environment above the background level. From the public health perspective, *environmental contamination* is addressed when it potentially affects the health and quality of life of people living and working near the contamination.

Environmental Media Usually refers to air, water and soil in which chemicals of interest are found. Sometimes, plants and animals that are eaten by people are included.

EPA Environmental Protection Agency. The federal agency which develops and enforces environmental laws to protect the environment and the public's health.

Epidemiologic Surveillance The ongoing, systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link in the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis, and dissemination linked to public health programs.

Epidemiology The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. The investigators try to determine if any factor is associated with the health effect.

Exposure Contact with a chemical by swallowing, breathing, or direct contact (such as through the skin or eyes). *Exposure* may be short term (acute) or long term (chronic).

Exposure Assessment The process of finding the ways people come into contact with chemicals, how often, and how long they come in contact with chemicals and the amounts of chemicals with which they come into contact.

Exposure Dose Reconstruction An approach that uses computational models and other approximation techniques to estimate cumulative amounts of hazardous substances

internalized by people at presumed or actual risk from contact with substances associated with hazardous waste sites.

Exposure Investigation The collection and analysis of site-specific information to determine if human populations have been exposed to hazardous substances. The site-specific information may include environmental sampling, exposure-dose reconstruction, biologic or biomedical testing, and evaluation of medical information. The information from an *exposure investigation* is included in public health assessments, health consultations, and public health advisories.

Exposure Pathways A description o f the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical. ATSDR defines an exposure pathway as having five parts:

1. Source of contamination
2. Environmental Media and Transport Mechanism
3. Point of exposure
4. Route of exposure
5. Receptor population.

When all five parts of an exposure pathway are present, it is called a Completed Exposure Pathway.

Exposure Registry A system for collecting and maintaining in a structured record, information on persons with documented environmental exposure(s). The *exposure registry* evolved from the need for fundamental information concerning the potential impact on human health of long-term exposure to low and moderate levels of hazardous substances.

Frequency How often a person is exposed to a chemical over time; for example, daily, once a week, once a month.

Geographic Information System (GIS) A computer hardware and software system designed to collect, manipulate, analyze, and display spatially referenced data for solving complex resource, environmental, and social problems.

Hazard A source of risk that does not necessarily imply potential for occurrence. A hazard produces risk only if an exposure pathway exists, and if exposures create the possibility of adverse consequences.

Hazardous Waste Substances that have been released or thrown away into the environment and that under certain conditions, could be harmful to people who come into contact with them.

Health Consultation A response to a specific question or request for information pertaining to a hazardous substance or facility (which includes waste sites). It often contains a time-critical element that necessitates a rapid response; therefore, it is a more limited response than an assessment.

Health Education A program of activities to promote health and provide information and training about hazardous substances in the environment that will result in the reduction of exposure, illness, or disease. This program--both national and site-specific in focus--includes diagnosis and treatment information for health care providers and activities in communities to enable them to prevent or mitigate the health effects from exposure to hazardous substances at hazardous waste sites.

Health Outcome Data A major source of data for public health assessments. The identification, review, and evaluation of health outcome parameters are interactive processes involving the health assessors, data source generators, and the local community. *Health outcome*

data are community specific and may be derived from databases at the local, state, and national levels, as well as from data collected by private health care organizations and professional institutions and associations. Databases to be considered include morbidity and mortality data, birth statistics, medical records, tumor and disease registries, surveillance data, and previously conducted health studies.

Health Investigation Any investigation of a defined population, using epidemiologic methods, which would assist in determining exposures or possible public health impact by defining health problems requiring further investigation through epidemiologic studies, environmental monitoring or sampling, and surveillance.

Health Outcomes Study An investigation of exposed persons designed to assist in identifying exposure or effects on public health. Health studies also define the health problems that require further inquiry by means of, for example, a health surveillance or epidemiologic study.

Health Professional Education Any activity or activities directed toward public health professionals and the local medical community. The purpose of this activity is to improve the knowledge, skill, and behavior of health professionals concerning medical surveillance, screening, and methods of diagnosing, treating, and preventing injury or disease related to exposure to hazardous substances. These activities may include immediately disseminating written materials or making database information available, presenting workshops and short courses, or, where appropriate, long-term follow-up activities.

Health Statistics Review Evaluation of information and relevant health outcome data for an involved population, including reports of injury, disease, or death in the community. Databases may be local, state, or national; information from private health care providers and organizations may also be used. Databases may include morbidity and mortality data, tumor and disease registries, birth statistics, and surveillance data.

Health Surveillance The periodic medical screening of a defined population for a specific disease or for biological markers of disease for which the population is, or is thought to be, at significantly increased risk. The program should include a mechanism to refer for treatment those persons who test positive for disease (also called Medical Monitoring).

Indeterminate Public Health Hazard This category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.

Ingestion Swallowing (such as eating or drinking). Chemicals can get in or on food, drink, utensils, cigarettes, or hands where they can be ingested. After *ingestion*, chemicals can be absorbed into the blood and distributed throughout the body.

Inhalation Breathing. Exposure may occur from inhaling contaminants because they can be deposited in the lungs, taken into the blood, or both.

LOAEL Lowest Observable Adverse Effects Level. The lowest dose of a chemical in a study or a group of studies that has caused harmful health effects in people or animals.

Media Soil, water, air, plants, animals, or any other parts of the environment that can contain contaminants.

Medical Monitoring The periodic medical testing to screen people at significant increased threat of disease.

Metabolism All the chemical reactions that enable the body to work. For example, food is *metabolized* (chemically changed) to supply the body with energy. Chemicals can be *metabolized* and made either more or less harmful by the body.

Metabolite Any product of metabolism.

Minimal Risk Level (MRL) An *MRL* is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. *MRLs* are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration via a given route of exposure. *MRLs* are based on noncancer health effects only. *MRLs* can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

Morbidity Illness or disease. Morbidity rate is the number of illnesses or cases of disease in a population.

National Exposure Registry A listing of persons exposed to hazardous substances. This listing is composed of chemical-specific subregistries. The primary purpose of the registry program is to create a large database of similarly exposed persons. This database is to be used to facilitate epidemiology research in ascertaining adverse health effects of persons exposed to low levels of chemicals over a long period.

National Priorities List (NPL) The Environmental Protection Agency's (EPA) listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose immediate threat to persons living or working near the release. These sites are most in need of cleanup.

National Toxicology Program (NTP) *NTP* conducts toxicological testing on those substances most frequently found at sites on the National Priorities List of the EPA, and which also have the greatest potential for human exposure.

NOAEL No Observable Adverse Effects Level. The highest dose of a chemical in a study or a group of studies that did not cause harmful health effects in people or animals.

No Apparent Public Health Hazard Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.

No Public Health Hazard Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

ppb Parts per billion = One part of chemical/pollutant per billion parts of water or soil.

ppm Parts per million = One part of chemical/pollutant per million parts of water or soil.

Plume An area of chemicals in a particular medium, such as air or groundwater, moving away from its source in a long band or column. A *plume* can be a column of smoke from a chimney or chemicals moving with groundwater.

Point of Exposure The place where someone can come into contact with a contaminated environmental medium (air, soil, water or food).

Population A group of people living in a certain area, or, the number of people living in a given area.

Potential Public Health Hazard Sites for which no conclusions about public health hazard can be made because data are lacking.

Potentially Exposed The condition where valid information, usually analytical environmental data, indicates the presence of contaminant(s) of a public health concern in one or more environmental media contacting humans (i.e., air, drinking water, soil, food chain, surface water), and there is evidence that some of those persons have an identified

route(s) of exposure (i.e., drinking contaminated water, breathing contaminated air, having contact with contaminated soil, or eating contaminated food).

PRP Potentially Responsible Party A company, government or person that may be responsible for causing contamination at a hazardous waste site. PRPs are expected to help pay for the cleanup of a site.

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

Public Comment An opportunity for the general public to comment on Agency findings or proposed activities. The public health assessment process, for example, includes the opportunity for public comment as the last step in the draft phase. The purposes of this activity are to 1) provide the public, particularly the community associated with a site, the opportunity to comment on the public health findings contained in the public health assessment, 2) evaluate whether the community health concerns have been adequately addressed, and 3) provide ATSDR with additional information.

Public Health Action Designed to prevent exposures and/or to mitigate or prevent adverse health effects in populations living near hazardous waste sites or releases. Public health actions can be identified from information developed in public health advisories, public health assessments, and health consultations. These actions include recommending the dissociation (separation) of individuals from exposures (for example, by providing an alternative water supply), conducting biologic indicators of exposure studies to assess exposure, and providing health education for health care providers and community members.

Public Health Advisory A statement by ATSDR containing a finding that a release of hazardous substances poses a significant risk to human health and recommending measures to be taken to reduce exposure and eliminate or substantially mitigate the significant risk to human health.

Public Health Assessment The evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects; also, the document resulting from that evaluation.

Public Health Hazard Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.

Public Health Statement The first chapter of an ATSDR toxicological profile. It is intended to be a health effects summary written in lay language for the target audience, that is, the general public, especially people living in the vicinity of a hazardous waste site or chemical release.

Receptor Population People who live or work in the path of one or more chemicals, and who could come into contact with them.

Reference Dose (RfD) An estimate, with safety factors built in, of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause harm.

Registry A system for collecting and maintaining, in a structured record, information on specific persons from a defined population. Preliminary analyses and reviews are performed.

Risk In risk assessment, the probability that something will cause injury, combined with the potential severity of that injury.

Risk Communication Activities to ensure that messages and strategies designed to prevent exposure, adverse human health effects, and diminished quality of life are effectively communicated to the public. As part of a broader prevention strategy, risk communication supports education efforts by promoting public awareness, increasing knowledge, and motivating individuals to take action to reduce their exposure to hazardous substances.

Route of Exposure The way in which a person may contact a chemical substance. There are three exposure routes: inhalation (breathing), ingestion (eating or drinking) and dermal contact (absorbing something through the skin).

Safety Factor Also called an Uncertainty Factor. When scientists do not have enough information to decide if an exposure will cause harm to people, they use "safety factor." and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is not likely to cause harm to people.

Sample Size The number of people or environmental samples that are needed for a health or environmental study.

Site-Specific Surveillance Epidemiologic surveillance activity designed to assess the specific occurrence of one or more defined health conditions among a specific population potentially exposed to hazardous substances in the environment.

Significant Health Risk Circumstances where people are being or could be exposed to hazardous substances at levels that pose an urgent public health hazard or a public health hazard; public health advisories are generally issued when urgent public health hazards have been identified.

Source of Contamination The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway.**

Special or Sensitive Populations People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics A branch of the math process of collecting, looking at, and summarizing data or information.

Substance-Specific Applied Research A program of research designed to fill data needs. Activities may include laboratory and other studies to determine short-term, intermediate, and long-term health effects from human exposure to a given substance; laboratory and other studies to determine organ-, site-, and system-specific acute and chronic toxicity; laboratory and other studies to determine the manner in which a substance is metabolized or to develop an understanding of the biokinetics of the substance; and, where there is the possibility of obtaining human exposure data, collecting that information.

Superfund Another name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which created ATSDR.

SARA Superfund Amendments and Reauthorization Act. The 1986 legislation that broadened ATSDR's responsibilities in the areas of public health assessments, establishment and maintenance of toxicologic databases, information dissemination, and medical education.

Surveillance Activities Those activities that evaluate exposure or trends in adverse health effects over a specified period of time. *Surveillance activities* address the ongoing systematic collection, analysis, and interpretation of health data in the process of describing and

monitoring a health event. Data obtained through surveillance are very important for appropriate decisions regarding the planning, evaluation, or implementation of public health interventions.

Survey A way to collect information or data from a group of people (**population**). Surveys can be done by phone, mail, or in person.

Synergistic effect A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.

Toxic Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.

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

Tumor Abnormal growth of tissue or cells that have formed a lump or mass.

Uncertainty factor see **Safety factor.**

Urgent Public Health Hazard This category is used in ATSDR's Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.

ATSDR-Specific Terms

Technical Assistance A *technical assist* is a written or an oral response to requests for technical information and public health recommendations. This information is frequently incorporated into a health consultation.

Toxicological Profile A document about a specific substance in which ATSDR scientists interpret all known information on the substance and specify the levels at which people may be harmed if exposed. The *toxicological profile* also identifies significant gaps in knowledge on the substance, and serves to initiate further research, where needed.

Voluntary Residents Tracking System A collection of persons who are contacted periodically, for a limited time, for the purpose of disseminating information or of coordinating other health-related services.

Appendix D

EPA Fact Sheet on Mine Waste

FACT SHEET

EPA Region 7

Mine Waste

February 2003

Introduction

The U.S. Environmental Protection Agency (EPA) Region 7 is providing this fact sheet as a public guidance on mine waste usage in the states of Missouri and Kansas. Some residual wastes from mining are a commercial commodity and have been used for many years. Proper use of the wastes can reduce some threats to the environment and to human health that currently exist. Removing mining waste piles can also bring non-productive land back to beneficial and safe use. However, improper uses of mine wastes may increase the threat to human health and the environment. The ultimate use of the material should not allow people, and in particular young children, to come into contact with the material easily.

Site Background

Historic lead and zinc mining in the Midwest was centered in two major areas: the Tri-State area covering more than 2,500 square miles in southwestern Missouri, southeastern Kansas, and northeastern Oklahoma and the Old Lead Belt covering about 110 square miles in southeastern Missouri. The first recorded mining occurred in the Old Lead Belt in about 1742. The production increased significantly in both the Tri-state area and the Old Lead Belt during the mid-1800s and lasted up to 1970. Currently production still occurs in a third area, the Viburnum Trend, in southeastern Missouri. Mining and milling of ore produced more than 500 million tons of wastes in the Tri-State area and about 250 million tons of wastes in the Old Lead Belt. More than 75 percent of the waste has been removed and used for many purposes over the years. Today, approximately 100 million tons of waste remain in the Tri-State area and 60 million tons in the Old Lead Belt. The EPA Region 7, the states of Kansas and Missouri, local communities, and private companies are working together to seek solutions to the potential adverse impacts of these mine wastes which are contaminated with lead, zinc, cadmium, and other metals.

Chat and Tailings

Ore production consisted of crushing and grinding the rock to standard sizes and separating the ore. Ore processing was accomplished in either a dry gravity separation or through a wet washing or flotation separation. Dry processes produced a fine gravel waste commonly called

"chat." The wet processes resulted in the creation of tailings ponds used to dispose of waste material after ore separation. The wastes from wet separation are typically sand and silt size and are called "tailings." Milling produces large chat waste piles and flat areas with tailings deposited in impoundments. Tailings generally contain higher concentrations of heavy metals and therefore present a higher risk to human health and the environment through ingestion.

Another lesser occurring type of mine waste is called development rock. Development rock is the waste rock generated in drilling shafts to the deep mines and therefore did not come from the major ore producing rocks. Typically, development rock consists of large boulders and is locally known as "bullrock." Smelters also operated historically in Kansas, Missouri, and Oklahoma; however, this fact sheet does not address smelter related wastes.

Legal Considerations

If waste material is used in a way that creates a threat to human health or the environment, the owner of the property and the party responsible for creating the hazardous situation could be liable for a cleanup under the Superfund law. Because these mine wastes often contain lead, cadmium, zinc or other metal contaminants at levels that present a risk to both human health and the environment, using them in situations that would allow people or ecological receptors (animals, plants, fish, etc.) to regularly come into contact with the material could result in unacceptable situations which could be considered a Superfund problem. The property owners, haulers, operators, and individuals or businesses that sell, buy, or use mine waste materials must ensure they are using the materials in a manner that prevents direct contact by humans and other receptors and is not detrimental to the environment.

Typical uses

The EPA and the states of Kansas and Missouri are willing to provide assistance in reviewing specific uses of mine wastes but have no formal approval procedures. The following is a list of typical uses of mine wastes with a general assessment of whether or not the use may result in significant human health or environmental threats. The list represents EPA Region 7's views on acceptable and unacceptable uses of mine wastes.

Mine waste uses that are not likely to present a threat to human health or the environment:

- Applications that bind material into a durable product. These would include its use as an aggregate in batch plants preparing asphalt and concrete.
- Applied below paving on asphalt or concrete roads and parking lots.
- Applications that cover the material with clean material particularly in areas that are not likely to ever be used for residential or public area development. Examples would include spreading chat around utility pipe in excavated trenches, or placing chat as deep fill on commercial sites.

- Applications that use the material as raw product for manufacturing a safe product, such as in manufacturing.

Mine waste uses that may present a threat to human health or the environment:

- Playground sand or surface material in play areas.
- Driveways, parking lots and roadways including roadway shoulders that are not paved.
- Residential usages in general. The placement in a residential setting could cause a problem in the future if an unknowing person excavated the material and allowed it to be re-exposed. Also, construction of residential homes or public use areas, such as parks or playgrounds on or very near mine waste piles may result in unacceptable exposures.
- Placement in public areas in which children play such as parks and school grounds.
- Placement of fill material which comes in contact with free-standing water in an excavation or with surface water.
- Sandblasting.
- Use as an agricultural soil amendment to adjust soil alkalinity.

Additional Information

If you would like additional information about this fact sheet or Superfund mining sites in Kansas or Missouri, please contact the EPA Region 7's Office of External Programs, 901 N. 5th Street, Kansas City, Kansas 66101, 1-913-551-7003, or toll-free, in Kansas and Missouri, 1-800-223-0425.