ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

NEWTON COUNTY MINE TAILINGS SITE
NEWTON COUNTY, MISSOURI
EPA FACILITY ID: MOD981507585
JANUARY 4, 2006

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.

Agency for Toxic Substances & Disease Registry ..... Julie L. Gerberding, M.D., M.P.H., Administrator
Howard Frumkin, M.D., Dr.P.H., Director

Division of Health Assessment and Consultation…. ..... William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement Branch ..... Lisa Calhoun Hayes, P.E., DEE, Acting Chief

Exposure Investigations and Consultation Branch ..... Susan M. Moore, Ph.D., Chief

Federal Facilities Assessment Branch ..... Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment Branch ..... Richard E. Gillig, M.C.P., Chief

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Additional copies of this report are available from:
National Technical Information Service, Springfield, Virginia
(703) 605-6000

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

PUBLIC HEALTH ASSESSMENT

NEWTON COUNTY MINE TAILINGS SITE

NEWTON COUNTY, MISSOURI

EPA FACILITY ID: MOD981507585

Prepared by:

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

TABLE OF CONTENTS

SUMMARY

The Newton County Mine Tailings Site was proposed by the U.S. Environmental Protection Agency (EPA) for the National Priorities List (NPL) on April 30, 2003, and was listed on September 29, 2003. The site was added to the NPL because of lead and cadmium contamination in ground water, which is extensively used for residential drinking water.

The Newton County Mine Tailings Site is located in southwest Missouri in the Tri-State Mining District. The Tri-State Mining District includes southwest Missouri, northeast Oklahoma, and southeast Kansas, covering approximately 2,500 square miles. This district produced lead and zinc from approximately 1850 until 1970, and was one of the foremost lead and zinc mining areas in the world. Newton County contains six former zinc and lead mining subdistricts: Granby; Spring City-Spurgeon; Diamond; Wentworth; Stark City; and the Jasper County Overlap (Appendix A, Figure 2).

Ore was mined underground and then milled and smelted on the surface. Mining, milling, and smelting waste was typically discarded on the ground surface in large waste piles. The wastes, known as chat or tailings, contained residual lead, zinc, and cadmium, that leached from these waste piles and contaminated the ground water by entering the ground through naturally occurring faults and numerous mineshafts. Tailings and chat were used around the area for construction activities including railroad ballasts, road/building fill material, aggregate for concrete, residential roads, driveways, and possibly as sandbox filler.

Abandoned mine shafts and exposed ore also contributed to ground water contamination. Underground mines were below the water table. When the mines were in operation, ground water was pumped out from the mining shafts. Once the mines in Newton County were abandoned, ground water filled up the mine voids and contacted abandoned mine shafts and exposed ore. Lead, cadmium, and zinc-contaminated ground water resulted when the oxygenated water leached metals from the exposed ore in the mines.

Sampling data from several investigations has indicated that the lead, zinc, and cadmium-contaminated ground water is present at multiple locations throughout the county. In addition to ground water contamination, surface soils in the area have elevated levels of lead. In the past, elevated levels of lead have also been detected in the ambient air (Appendix B).

Removal actions for contaminated soil in residential yards are near completion. Residents with contaminated drinking water were offered free bottled water for domestic use on an interim measure. In 2003, EPA conducted an Engineering Evaluation and Cost Analysis (EE/CA) to compare alternatives for a removal action for controlling releases of contaminated ground water at the Newton County site. The preferred alternative is connecting residents to the existing public water supply district. An alternate option includes drilling new deep aquifer wells. Under the preferred option, new water lines will be extended from the existing public water mains from Joplin, Mo, and from existing water supplies in Diamond and Granby to residences with contaminated ground water. If new deep aquifer wells are drilled, restrictions will ensure that new wells will not be drilled into the contaminated ground water zone, and that current wells are

abandoned properly to ensure that they do not contribute to further contamination. This alternative recommends strong enforcement of the Missouri Well Driller's Law that includes proper casing depth, casing integrity, and proper abandonment of wells that reach into the deep aquifer. Wells that are not abandoned properly can act as a conduit for contamination to enter the deep aquifer. Nineteen households that are too remote to be connected to public water supplies will be provided with new deep-aquifer water wells. The bottled water program will continue until needed water supply infrastructure is in place and fully operational.

Although all potential sources of lead, cadmium, and zinc contamination have not been determined at this time, several source areas have been identified. Ground water, surface water, soils, and ambient air samples have contained elevated levels of lead, cadmium, and/or zinc. The points of exposure are individual households who have private drinking water wells that draw from the upper aquifer and residential areas that have contaminated soil in yards or are near tailing piles.

Past, present, and future potential exposure pathways exist at the Newton County site. In the past, residents could have been exposed to contaminated air, soil, surface water, and ground water. Presently and in the future, private well users have the potential to be exposed to contaminated water through their private drinking wells. The exposure could occur if the contamination spreads through the ground water or if additional private wells are drilled into the contaminated aquifer. There is also the potential for surface water contamination and additional residential soil contamination through wind and water erosion of tailings piles or if yards are watered using contaminated water from residential wells. Residents could be exposed to contaminated ambient air if the fine particles of the tailings pile become airborne.

The Newton County site has been classified as a public health hazard for past, present and future exposure. A site that is classified as a public health hazard poses a health risk as a result of long-term exposures to hazardous substances. These classifications are based on the following conclusions:

- Lead and cadmium contamination present in the ground water at levels above current health based drinking water limits.

- Some residential yards in all the subdistricts and Spring City area were found to have lead levels above site-specific removal action limits.

- High levels of contaminants are present at the source areas that have yet to be remediated; therefore, exposure may occur to remediation workers, trespassers, and others that may occupy or work around the source areas. Exposure could also occur if the area is developed or used for other purposes before it is completely remediated.

For an explanation of terms and acronyms used in this document, refer to Appendix D.

PURPOSE AND HEALTH ISSUES

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), is evaluating the public health impact of the Newton County Mine Tailings Site. 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. The US Environmental Protection Agency (EPA) proposed the Newton County Mine Tailings Site for listing on the National Priorities List (NPL) on April 30, 2003. The listing was finalized on September 29, 2003. The site was added to the NPL because of the lead and cadmium contamination in residential drinking water wells at levels substantially above current health based drinking water limits. This public health assessment will assess past, present, and future human exposure to contaminants at the site. It will determine if any past, present, or future exposures are at levels expected to cause adverse health effects. This assessment also recommends actions to reduce or prevent possible adverse human health effects from exposures to this site.

BACKGROUND

The Newton County Mine Tailings Site (Newton County site) is located in southwest Missouri in the Tri-State Mining District (Appendix A, Figures 1 and 2). The Tri-State Mining District includes southwest Missouri, northeast Oklahoma, and southeast Kansas, covering approximately 2,500 square miles. This district produced lead and zinc from approximately 1850 until 1970 and was one of the foremost lead and zinc mining areas in the world. Newton County contains six former zinc and lead mining subdistricts: Granby; Spring City-Spurgeon; Diamond; Wentworth; Stark City; and the Jasper County Overlap (1) (Appendix A, Figures 1 and 2).

In Newton County, underground mines were below the water table. Therefore, when the mines were in operation, ground water had to be pumped out from the mining shafts. After the mines were abandoned, the water table returned to its natural level, flooding the mine voids. Ground water came into contact with the mine shafts and exposed residual ore. Lead, cadmium, and zinc contaminated ground water resulted when the oxygenated water leached metals from the exposed ore in the mines (1).

Ore was mined underground, then milled and smelted on the surface. The milling processes included crushing, grinding, gravity concentration, and floatation. The resulting waste from mining, milling, and smelting was typically discarded on the ground surface. This practice led to the growth of large waste piles of development rock, chat, sands, fine tailings, and slag. Lead, zinc, and cadmium leached from these waste piles and contaminated the ground water by entering the ground through naturally occurring faults and numerous mineshafts (1).

The waste piles are commonly referred to as tailings and/or chat piles. The tailings are classified as medium to fine sand-sized particles that are a waste product of the froth floatation-level extraction process. Chat is defined as crushed ore material that is 3/8 inch or less in diameter. Chat was primarily milled with the density separation process. Material from these waste piles, tailings, and/or chat, were partially used for construction activities, including railroad ballast, road/building fill material, and aggregate for concrete and asphalt (2). The materials were also used for residential roads, driveways, and possibly as sandbox filler. The tailings and chat piles contain concentrations of heavy metals and metal sulfides associated with lead and zinc mining operations. Chat was primarily milled with the density separation process. Chat wastes are more resistant to erosion; however, historically contained larger quantities of heavy metals. Of the two waste types, tailings have historically been more susceptible to wind and water erosion. Human exposure to heavy metals and metal sulfides has occurred due to the widespread use of the material from the waste piles. EPA Region 7's Fact Sheet on Mine Waste for proper use of the material from the waste piles can be found in Appendix E.

Based on sampling data collected in 1995, 1998 and 2000, the lead, zinc, and cadmium contaminated ground water has been found at multiple locations throughout the county. In addition to ground water contamination, surface soils in the area have elevated levels of lead and cadmium.

Site Investigations

In 1986, EPA conducted a Preliminary Assessment (PA) of the Newton County site. One soil, three ground water, and three sediment samples were collected and analyzed for metals (2). The soil sample result was compared to established 1980 EPA acceptable concentrations for soil. Three metals were found to be above acceptable concentrations: lead, manganese, and zinc. The ground water samples were taken from residential wells that were being used for drinking water. The metal concentrations found in these samples were within EPA's acceptable drinking water standards for metals at the time. The sediment samples were taken from streams that channel surface water runoff from tailings piles. These samples were compared to the background benchmark and found to have elevated levels of aluminum, cadmium, calcium, copper, lead, magnesium, mercury, and zinc (2).

In 1989, the Missouri Department of Natural Resources (MDNR) conducted a site investigation of the area. One surface water, one soil (0-6 inches in depth), and three eight-hour air samples were collected and analyzed for total lead (3). The surface water sample was taken from a pond near the base of a chat pile. The amount of lead in this sample was within the acceptable drinking water standards at the time. The soil sample was taken directly from a tailings pile and was analyzed for total lead content (Table 1). The level of lead in this sample was below the 1980 EPA established acceptable benchmark for lead concentration. One of the three air samples taken in the area was above the National Ambient Air Quality Standards (NAAQS)/ National Emissions Standards for Hazardous Air Pollutants (NESHAPS) benchmark for lead (3).

In 1991, the Missouri Department of Health conducted blood-lead and urine-cadmium screening at 302 households in Jasper County, an adjacent county in the Tri-State District. The Jasper

County site has a mix of mining/milling and smelting wastes. The study found 14% of the children tested that were under seven years of age had elevated blood-lead levels (4). As a result, EPA began a removal assessment focused on the smelter area in January of 1995. The existing data indicated that the smelter's zone of influence was at least 0.5 miles. In Joplin, more than 1,300 residential yards within 0.75-1.5 miles from a smelter were screened using a field portable X-ray fluorescence spectrometer (XRF) (4).

Within Joplin and the outlying communities, removal actions were conducted at residences where a child under the age of seven had a blood lead level of 15 micrograms per deciliter (ug/dl) or greater and where the concentration of lead in the yard soil exceeded 500 milligrams per kilogram (mg/kg) in 1996. Also, removal actions were initiated in areas where the soil at any licensed day-care facility was found to have a soil lead concentration above 500 mg/kg (4). The targets for removal action were eventually extended to any residential yard soils where there was at least one XRF reading of 2,500 mg/kg or higher, and the contamination was determined to have originated from sources other than lead-based paint (4).

A previous assessment south of Joplin, in Spring City, Missouri, involved residential soil screening/sampling and drinking water sampling at 40 homes. Lead concentrations higher than 500 mg/kg were detected in the soil at 11 residences. Two of these 11 locations had concentrations that exceeded 2,500 mg/kg. The water samples were compared to EPA's Maximum Contaminant Levels (MCL) or EPA action levels. An MCL is the maximum concentration of a contaminant allowed by the EPA in public drinking water. Seven of the 40 residences had lead levels in their drinking water above the action level of 15 micrograms per liter (ug/L), eleven residences had cadmium levels above the MCL of 5 ug/L, and zinc levels above the EPA action level of 5,000 ug/L were detected at three residences (4).

In 1995, EPA received reports of elevated blood lead levels in children living in the counties around Newton County with similar mining histories. Consequently, EPA conducted limited sampling around the city of Granby, followed by more extensive ground water and soil sampling throughout Newton County in 1998 and 2000 (1). During EPA's 1995 Expanded Site Inspection, 20 tailings samples were collected from 18 different tailings piles throughout Granby, Wentworth, and Stark City. Cadmium was detected as high as 196 mg/kg, with an average of 135 mg/kg; and lead was detected as high as 23,300 mg/kg, with a median of 398 mg/kg (5). The 1998 soil sampling indicated that surface soils in the city of Granby had lead levels as high as 33,500 mg/kg (1).

In 1998, EPA conducted a Removal Site Evaluation (RSE) in the Diamond and Granby Subdistricts. This RSE used the action levels for drinking water and residential soil from the Administrative Order on Consent (AOC) signed by EPA and ASARCO and Goldfields/Blue Tee. For drinking water, the action levels were 5 micrograms per liter (ug/L) for cadmium, 15 ug/L for lead, and 5,000 ug/L for zinc (6). Ground water samples were collected at 50% of the rural residences in the Diamond mining subdistrict and 60% of the rural residences in the Granby mining subdistrict (6). Following the precedent set in Jasper County; a time-critical removal soil action level of 2,500 mg/kg of lead was established at the Newton County site. A non-time-critical removal action level was established for lead of levels less than 2,500 mg/kg but greater than 800 mg/kg. Composite soil samples were collected at 21% of the urban or grouped

residences in the Diamond mining subdistrict and 24% of the urban or grouped residences in the Granby mining subdistrict (6).

In the Diamond subdistrict, it is believed that mining and smelting did not take place within the town of Diamond. None of the samples collected at the 395 residential yards exceeded the AOC action level for lead. However, the ground water in the area does appear to be somewhat contaminated; eight out of the 75 private drinking water samples collected did exceed the AOC action levels for cadmium, lead and/or zinc (6).

In the Granby subdistrict, soil samples collected from seven residential yards exceeded the AOC action level for lead. Three out of the seven are in close proximity to the former smelter and did meet the criteria specified in the AOC for time-critical removal action (6). The other four are likely influenced by non-mining related sources and do not meet the criteria specified in the AOC for time-critical removal action. Six out of 83 private drinking water samples collected in the Granby mining subdistrict exceeded the AOC action levels for cadmium, lead, and/or zinc (6).

In 1999-2003, a removal action was carried out to remove contaminated soils from residential yards. Removal actions were conducted for approximately 350 residential yards that were determined to contain lead concentrations above the action level of 800 mg/kg (4). Contaminated soil was excavated and replaced with clean topsoil. A repository for excavated soil was established on mine waste-contaminated property near Granby owned by Newton County. All contaminated soil excavated from the sites was placed in the new soil repository. Access to the soil repository is controlled to prevent exposure and controls are in place to prevent future use and exposure. Approximately thirty property owners with residential yards containing lead over the action level denied access to their property for soil excavation.

In March 2000, private well sampling was conducted throughout Newton County, including the cities of Joplin, Wentworth, Seneca, Diamond, Pierce City, Neosho, and Racine. Ground water samples were taken at 1,465 residences that have private wells. The samples were tested for total lead, cadmium, and zinc. The results indicated an additional 340 homes with ground water contamination above action levels. The private well sampling results for lead ranged from none detected to 1,290 micrograms per liter (ug/L) with the mean value from the homes above action levels being 65 ug/L. The well sampling results for cadmium ranged from none detected to 224 ug/L and from the 340 wells above the action level, the mean value was 16 ug/L. The well sampling results for zinc ranged from none detected to 11,500 ug/L, the mean value from the 340 wells above the action level was 5,417 ug/L (4). As of August 2003, approximately 500 homes were receiving bottled water (4). Some residents (approximately 73 households) refused the bottled water.

While Newton County is sparsely populated, the risk of adverse health effects for current residents who have contaminated drinking water wells is high. Also, additional residents are at risk for having their wells contaminated, if the contaminants migrate or new wells are drilled into the contaminated aquifer. Therefore, EPA determined that a removal action is justified. An Engineering Evaluation and Cost Analysis (EE/CA) conducted by EPA in 2003 compared alternatives for a removal action on the basis of effectiveness, cost, implementability, and other

factors. The EE/CA considered seven removal action alternatives for controlling releases of contaminated ground water at the Newton County site (4). The objective of the non-time critical removal action is to mitigate the threat to public health or to the environment from contaminated ground water. The focus area of the EE/CA includes the majority of Newton County, including Diamond, Granby, and Wentworth.

The seven removal alternatives considered were:

Alternative No. 1.	No action.
Alternative No. 2	Bottled water program plus institutional controls and monitoring.
Alternative No. 3	Point-of-use treatment plus institutional controls and monitoring.
Alternative No. 4	Drilling new wells to the deep aquifer for each residence plus institutional controls and monitoring.
Alternative No. 5	Drilling new deep wells for clusters of residences plus institutional controls and monitoring.
Alternative No. 6	Establishing a rural water district plus institutional controls, connection to existing public water supply district and new wells.
Alternative No. 7	Connection to existing public water supply district plus institutional controls and new wells.

Institutional controls are legal or administrative actions or requirements that are established to protect human health or the environment. At this site, the Missouri's Well Driller's Law (which governs proper casing depth, casing integrity, and proper abandonment of any existing or new wells) provides the appropriate institutional controls to protect the integrity of the lower aquifer. Drilling new shallow wells would be restricted and an aquifer protection provision of the Missouri Well Driller's Law would be enforced (4).

EPA is currently implementing alternative No. 7. The new water lines are being extended from the existing mains from Missouri American Water Company in Joplin, Mo, and from existing water supplies in Diamond and Granby to residences with contaminated ground water. Nineteen households that are too remote to be connected to public water supplies will be provided with new deep aquifer water wells. The bottled water program will continue until needed infrastructure is in place and fully operational (4).

This alternative is slightly more costly than drilling a new well for each residence to the deep aquifer. However, it better meets the remediation goals by creating a more permanent remedy without a strong reliance on institutional controls, or the dependence upon extensive operation and maintenance. Approximately 500 homes are receiving bottled water and could be connected to the existing system. Another approximate 1,500 threatened households might be connected to existing systems (4).

Source Areas

Because of the high density of tailings piles, contaminated soil, underground exposed ores, and unpredictable ground water flow caused by numerous underground fractures, karst geology, and

mine workings, it is not possible to identify any specific sources of lead and cadmium ground water contamination at this time (7).

According to the 1986 Preliminary Assessment conducted by EPA and the Site Inspection conducted by Missouri Department of Natural Resources (MDNR), the entire town of Granby was built on mine waste and potentially exposed to contaminants. At one time, there was a smelter located in northwest Granby. The city of Granby was considered to be a potential source area of soil contamination. Evidence of the former mining activities include at least six chat piles located within the city limits south of Granby (4). The largest identifiable tailings/chat pile of 166 acres is located approximately 0.75 miles southwest of Granby and is referred to as the Prairie Run Tailings (2).

Childhood Blood Lead Testing

Newton County Health Department's records for childhood blood lead testing were analyzed in an effort to determine if the children in Newton County have been exposed to elevated lead levels. In 1997, 2% of the children under six years of age in Newton County (76 out of approximately 3895 children) had their blood lead level tested. Only 1% of the 76 children tested had levels above 10 micrograms per deciliter (ug/dl). In 1998, 8%, of children that were tested (71 out of 3895), had elevated blood lead levels. In 1999, 5%, of the children tested (193 out of 3895), had elevated levels. In 2000, testing increased with 16% of the children six years of age and younger being tested (609 out of approximately 3895 children). Of that 16% tested, 3% had levels over 10 ug/dl.

According to 2002 local health department records, there were approximately 4,458 children under six years of age in Newton County. For the calendar year 2001, 11% of the children less than six years old in Newton County had their blood lead level tested. Of that 11%, 3% had levels above 10 ug/dl. For the calendar year 2002, only 8% of the children were tested with 1% being elevated.

With only an average of 7% of the children that are six years of age and younger being tested over a period of six years, it is difficult to determine the overall percent of children with elevated blood lead in the county.

Geology and Land Use

Because of the area's karst geology and the altered rock layers from past mining activities, local ground water patterns can be unpredictable (2). It is believed that the karst geology and/or the altered horizons may exist to depths of 300 feet. In general, the ground water in Newton County is believed to flow in a west to northwest direction.

There are two aquifer systems in the Newton County, referred to as the upper and lower aquifers. The upper aquifer varies seasonally and ranges from 60 to 150 feet in saturated thickness. The host rock for the upper aquifer is Mississippian aged cherty limestones. Shallow residential

wells draw from this aquifer (2). Underlying the Mississippian limestone is a 10 to 20 foot thick Devonian age Chattanooga shale. It is believed to act as a confining layer between the upper and lower aquifer. Below the shale layer is a Cambrian and Ordovician-aged dolomite and sandstone layer with shaley zones. The saturated thickness ranges from 150-650 feet. The City of Granby's wells draw from this aquifer.

It is assumed that the upper and lower aquifers are hydraulically connected due to the lack of definitive documentation as to the hydraulic integrity of the upper and lower aquifer (2). Leakage of ground water downward from the shallow aquifer in the Mississippian limestone rocks to the lower aquifer is possible where the confining layer is thin or absent, as in northwestern Newton County, and where fractures and faults are present (7). The shallow aquifer is generally a source of replenishment to the deeper aquifer and can be a source of contamination in the mining areas throughout Newton County.

Soils in the Granby area are mostly silty soils less than two feet in thickness. The silty layer overlies a residual layer comprised of red clay and chert. The soils are moderately permeable in clay zones and highly permeable where soils have been eroded away and cherty zones remain.

This area is predominantly rural with most land used for pasture and other agricultural uses. Aside from the past mining industries, there are also manufacturing, construction, retail, and healthcare industries in the area.

Surface Water

The surface waters in the Granby area are generally characterized as flowing and intermittent streams that flow north towards Shoal Creek. A portion of the surface runoff from the Prairie Run tailings pile flows west approximately one mile then to the north meeting Shoal Creek. There are three primary tributaries that drain the Tri-State Mining area at Granby: Gum Spring branch to the east, Dry branch to the southwest, and Wolf Creek to the west of Granby; all of which feed Shoal Creek to the north (2).

There is one surface water intake, approximately seven miles downstream from the confluence of Shoal Creek and the Gum Spring branch, which partially serves the city of Neosho. The surface water intake alone serves approximately 4,482 persons. Shoal Creek flows westerly to Neosho from Granby at an annual average rate of 406 cubic feet per second (2).

Shoal creek is utilized as a recreational stream, local fishery, and for livestock watering. There is at least one federally designated endangered species, the Ozark Cavefish, in the surface water pathway. There are no data available for the sediment or water in Shoal Creek.

Physical Hazards

Physical hazards at the Newton County site are associated with the abandoned mines and the tailings or chat piles. Open mine shafts, exploratory mine shafts, or air vents could be present on

or near mine properties. These open holes could be dangerous to workers or trespassers, especially children who could potentially step or fall into one of the holes. Climbing or walking on the tailings and chat piles could be treacherous. The piles are very unstable; collapses or washouts are possible. Large debris or pieces of steel could be in the tailings causing a hazard for anyone walking on the piles. Workers or trespassers are expected to be at risk of harm because of these physical hazards.

Demographics

According to the 2000 U.S. Census, Newton County has a total population of 52,636 residents. Of that total, 93% were white, 2% asian, 0.5% black, with the remaining population being some other race alone or two or more races combined. In 2000, 14% of the population was over the age of 65 and 7% were under the age of five. As of 2000, the median household income in Newton County was $35,041 (8).

More specifically, in 2003, the City of Granby had a population of 4,567 (8). Of that population, 95% were white, 0.2% were black, 1.8% were American Indian, 0.3% were asian or pacific islander, 0.8% were some other race, and the remaining 1.8% were two or more races (9). The 2003 median household income in Granby was $33,571, with 11.5% of families living below the poverty level in 2000 (9, 8).

In Diamond, the population in 2003 was 2,559 residents (9). Of that population, 95% were white, 0.6% were black, 1.6% were American Indian, 0.2% were asian or pacific islander, 0.8% were some other race, and the remaining 1.9% were two or more races (9). In 2003, the median household income in Diamond was $36,936, with 6.2% of families living below the poverty level in 2000 (9, 8).

DISCUSSION

In Newton County, lead, cadmium, and/or zinc contamination has been found in the air, soil, and water. Exposure to these contaminants varies greatly depending on the area and the contaminated media. Most of the exposure has occurred for several years. Cadmium and zinc have been found in drinking water at levels that exceed EPA MCL values and ATSDR's comparison values (CVs) and minimal risk levels (MRLs). ATSDR has developed CVs that are 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. Contaminant levels above the CV do no necessarily indicate that a health threat is present, but that further evaluation of the chemical and pathways is needed. Minimal Risk Levels (MRLs) are 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. Lead has been found in drinking water and soil at levels that exceed EPA action levels. ATSDR does not have CVs or MRLs for lead.

Cadmium and zinc have been found at elevated levels in residential drinking water wells in Newton County. The completed pathway of concern is ingestion of contaminated water. Ground water and surface soils in parts of Newton County contain elevated levels of lead. The completed pathways of concern are ingestion of contaminated water and incidental ingestion and inhalation of lead-contaminated soil and dust, especially for children. Children are most susceptible to lead in contaminated soil due to their hand-to-mouth activities. Compared to adults, a greater proportion of the lead swallowed will enter the blood of children. Only about 32% of lead taken into the body of a child will leave as waste, indicating accumulation of lead in the child's system (10). The Centers for Disease Control and Prevention (CDC) considers lead poisoning the number one preventable pediatric health problem facing children in the United States. Several signs of lead toxicity have been described at low levels of exposure. They include decreased attention span, hyperactivity, and lower IQ scores.

Pathway Analysis

To determine whether residents of Newton County have been or are being exposed to contaminants, DHSS evaluated the environmental and human components that lead to an exposure pathway. There are five elements that ATSDR considers necessary for a completed exposure pathway. The five elements are: 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 exist when the five elements of a pathway link the contaminant source to a receptor population. Potential exposure pathways exist if at least one of the five elements is missing or uncertain, but could exist. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. Completed and potential exposure pathways could have occurred in the past, could be presently occurring, or could occur in the future (11). Appendix B, Table 2 lists the exposure pathways present at the Newton County site.

Completed Exposure Pathways

Past:

Completed exposure pathways existed at the Newton County site in the past. The five elements of a completed exposure pathway are listed below:

1. **Contaminant source** – tailings piles and exposed ore in abandoned mines.
2. **Environmental medium and transport** – contaminated water and soil.
3. **Point of exposure** – private drinking wells, soil, and surface waters.
4. **Route of exposure** – ingestion and inhalation.
5. **Receptor population** – private well users and those who ingest contaminated soil, and surface water.

Although all of the potential sources of lead, cadmium, and zinc contamination have not been determined at this time, several source areas have been identified. Ground water, surface water, and soils are contaminated with lead, cadmium, and/or zinc.

Removal actions to excavate contaminated yards in the city of Granby have been completed. Several hundred properties were found to have elevated lead levels in the surface soil. Presently, it is assumed that all contaminated yards above the action levels have been excavated and replaced with clean topsoil.

Present:

The point of exposure is individual households that have private drinking water wells that draw from the upper aquifer. According to 2000 sampling data, more than 200 private drinking wells were found to have elevated levels of lead. As of August 2003, at least 500 residents were receiving bottled water provided by EPA. However, some residents did not accept the bottled water. In early 2004, construction began to connect accessible residences to the public water system. For 19 residences that are too remote to be connected to the public water system, new private wells will be drilled to the lower aquifer.

Potential Exposure Pathways

Past and present potential exposure pathways exist at the Newton County site. In the past, residents could have been exposed to contaminated soil, surface water, and ground water. Presently and in the future, additional private well users have the potential to be exposed to contaminated water through their private drinking wells. If residents do not accept EPA's remedy by not connecting to the public water system expansion or allowing new well construction, residents still have the potential for exposure to lead in their drinking water. Exposure could also occur if the contamination spreads through the ground water or if additional private wells are drilled into the contaminated aquifer. Also, some residents have refused participation in the bottled water program and some have not allowed access for drinking water sampling.

In the future, there is the potential for surface water contamination and additional residential soil contamination through wind and water erosion of the tailings piles, or if yards are watered using contaminated water from the residential wells. Mine waste can still be found throughout the area. One previous air sample detected elevated levels of lead in the ambient air, indicating that fine particles from the tailing piles or other source areas had become airborne. Residents could be exposed to contaminated ambient air if the fine particles become airborne. Another potential pathway of concern is vegetables grown in lead contaminated soil. 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 (10).

Because of the ground water flow in the area and the extent of contamination, there is the potential for the water of Shoal Creek to be contaminated. Several smaller branches from the area flow into this bigger creek. Shoal Creek is used as a recreational stream, local fishery, and

for livestock watering. Therefore, there is the potential for exposure if the surface water or sediment in the creek is contaminated.

TOXICOLOGICAL EVALUATION

This section will discuss the potential adverse health effects of exposure to cadmium, lead, and zinc. Non-cancerous health effects and the likelihood of the contaminants causing cancer will be evaluated. Contaminant levels are compared to CVs developed by ATSDR and EPA. Environmental media evaluation guides (EMEGs) are CVs that have been derived for a variety of chemicals in various media. Minimal Risk Levels (MRLs) are 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 can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes. Acute exposure is defined as exposure that occurs for less than 14 days. Intermediate exposure occurs for more than 14 days but less than 364. Chronic exposure occurs for more than 365 days.

Cadmium

Cadmium is a soft, silver-white metal that occurs naturally in the earth's crust. Cadmium is not usually present in the environment as a pure metal, but as a mineral combined with other elements. It is most often present in nature as complex oxides, sulfides, and carbonates in zinc, lead, and copper ores (12). Cadmium has many industrial uses and consumer products, mainly in batteries, pigments, metal coatings, plastics, and some metal alloys.

The exposure route of concern for cadmium in Newton County is ingestion of contaminated drinking water. Ingestion of high levels of cadmium in contaminated food or water can severely irritate the stomach, leading to vomiting and diarrhea, and sometimes death. Cadmium is a cumulative toxicant and ingestion of lower levels for a long period of time can lead to a buildup of cadmium in the kidneys and, possibly, kidney damage. The kidney is the main target organ for cadmium toxicity following chronic-duration exposure by oral routes (12).

The MRL for chronic ingestion of cadmium is 0.2 micrograms per kilogram per day (ug/kg/day) for adults. The current average dietary intake of adult Americans is approximately 0.4 ug/kg/day and smokers take in about an equal amount from cigarettes (12). This indicates that Americans currently do not have a large margin of safety with respect to cadmium intake.

In Appendix C, the estimated contaminant dose for adults and children was calculated using the mean and maximum values. Using the mean level detected of 16 ug/L in drinking water, the estimated contaminant dose for adults is 0.46 ug/kg/day and for children 1.6 ug/kg/day. Using the maximum detected level, the estimated contaminant dose for adults is 6.4 ug/kg/day and for children is 22.4 ug/kg/day. Appendix C shows the complete calculations for the estimated contaminant doses for cadmium. The values are not representative of every individual resident of Newton County's intake of cadmium. However, it does indicate that some residents were

exposed to levels of cadmium that could be harmful to their health. If residents consumed water from their residential drinking water wells with high levels of cadmium for several years, adverse health effects may occur.

Lead

Lead is a naturally occurring metal found in the earth's crust. It has no characteristic taste or smell. It is mined and processed for use in various industries. It is used in some types of batteries, ammunition, ceramic glazes, medical equipment, scientific equipment, and military equipment. At one time, lead was used as an additive in gasoline and in paint. Lead was released into the air in automotive exhaust and deposited along roadways when it was in gasoline. Lead in the soils in the inner cities is often attributable to the use of paint containing lead (10). The practice of depositing mine tailings above ground has made a large volume of lead more accessible to people in former mining areas.

Lead has no nutritional benefit for humans. There is no safe level of exposure to lead. Exposure to lead can occur by inhalation or ingestion, with the effects on the body being the same. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure. Lead has the greatest effect on the nervous system in adults, and especially in children. Lead exposure can cause impaired mental and physical development, decreased hemoglobin synthesis, loss of hearing, and decreased serum levels of vitamin D. Lead adversely affects the peripheral motor neurons causing weakness in fingers, wrists, and ankles. At high levels, lead can damage the brain and kidneys. Pregnant women can experience miscarriage if exposed to high levels of lead (10). High-levels exposure in men can be damaging to the organs responsible for sperm production.

The Centers for Disease Control considers children to have an elevated lead if the amount of lead in the blood is at least 10 micrograms per deciliter (10 µg/dl). Studies have shown that there is a definite correlation between soil lead concentrations and blood lead levels in children. In general, blood lead levels increase as the lead concentrations in soil and dust increase. As blood lead levels increase the likelihood of adverse health affects also increases. It has been shown that children with low blood lead levels may exhibit adverse health affects such as learning difficulties and behavioral problems.

Although EPA considers lead to be a B2 carcinogen (probable human carcinogen, inadequate human, sufficient animal studies), no studies in humans were found to indicate that inorganic lead was carcinogenic to humans after inhalation or ingestion exposure (10). The National Toxicity 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 (13).

The lead levels found in the soil and water in Newton County exceed lead action levels for soil and EPA action levels for water. Residents, especially children, could be at risk for adverse health effects.

Zinc

Zinc is a common element found in the air, soil, water, and all foods. It is mined for use in various industries, including iron coating, brass and bronze, pennies, and dry cell batteries. Different types of food contain different levels of zinc. Leafy vegetables contain minimal levels (2 ppm) and meats, fish, and poultry contain higher levels (29 ppm) (14). Zinc is also in most drinking water. The levels can be higher if the water is stored in metal containers or flows through pipes coated with zinc to resist rust. Zinc is an essential element needed by the body in small amounts (14). A lack of zinc, as well as an excess of zinc, can be harmful to human health.

Inhaling large amounts of zinc dust or fumes can cause a specific short-term disease called metal fume fever (14). Long-term effects of breathing zinc dust or fumes are not known. The levels of zinc that must be consumed to cause adverse health effects are 10 to 15 times higher than the Recommended Daily Allowance (RDA) for zinc. For men the RDA is 15 mg/day and for women, it is 12 mg/day (14). If extremely high levels are taken by mouth for a short time, stomach cramps, nausea, and vomiting may occur. If large doses are ingested for several months, anemia, damage to the pancreas, and decreased levels of high-density lipoprotein (HDL) cholesterol may occur. It is unknown whether high levels of zinc affect the reproductive system or cause birth defects in humans (14).

Without adequate amounts of zinc in the diet, people may experience loss of appetite, decreased sense of taste and smell, decreased immune function, slow wound healing, and skin sores. Young men that have too little zinc in their diet can have poorly developed sex organs and retarded growth. Zinc is important for pregnant women to ensure their babies do not experience growth retardation (14).

In Appendix C, the estimated contaminant dose for adults and children was calculated using the mean and maximum values. The MRL for chronic exposure to zinc is 300 ug/kg/day and for intermediate exposure is also 300 ug/kg/day. Using the mean level detected of 5,417 ug/L, the estimated contaminant dose for adults is 155 ug/kg/day and 541.7 ug/kg/day for children. Using the maximum level detected, the estimated contaminant dose for adults is 329 ug/kg/day and is 1,150 ug/kg/day for children. Appendix C shows the complete calculations for the estimated contaminant doses for zinc. The values are not representative of every individual resident of Newton County's intake of zinc. However, it does indicate that portions of residents were exposed to levels of zinc in drinking water that could be harmful to their health.

Children's Health

In general, children are more likely than adults to become exposed to contaminants in soil or water. In their daily activities, children have a tendency to have frequent hand-to-mouth contact and introduce non-food items into their mouths. Because children are smaller and their bodies

typically retain more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

The effects of exposure to elevated levels cadmium on children is expected to be similar to the effects on adults. Ingestion of high levels of cadmium in contaminated food or water can severely irritate the stomach, leading to vomiting and diarrhea, and sometimes death (12). Ingestion of lower levels of cadmium over an extended period of time can lead to buildup in the kidneys, and possibly, kidney damage.

Children are more susceptible to lead poisoning than adults and are more likely to be exposed to lead contaminated materials. Infants and young children can swallow and breathe lead in dirt, dust, or sand while they play on the floor or ground. Also, compared to adults, a bigger proportion of the amount of lead swallowed will enter the blood in children (10). While about 99% of the amount of lead taken into the body of an adult will leave as waste within a few weeks, only about 32% of lead taken into the body of a child will leave as waste (10). This can cause accumulation of lead in the child's system.

When children are exposed to lead contaminated materials, a variety of adverse health effects can occur depending on the level of lead to which they are exposed and the duration of exposure. These effects include learning disabilities, slowed growth, hyperactivity, impaired hearing, and at very high exposure levels, even brain damage (10). Lead has the greatest effect on the nervous system, in adults and especially in children. In children, low levels of lead can cause weakness in fingers, wrists, or ankles. Unborn children can also be exposed to lead through their mothers and are at risk of premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (10).

Regular blood-lead testing before a child is six years old is key to determining if the child has been exposed. In Newton County, testing has shown that there are children with elevated blood lead levels. However, with only an average of 7% of the children that are six years of age and younger being tested over a period of six years, it is difficult to accurately determine the overall blood lead level for children in the county. Eliminating exposure pathways by controlling contamination sources, practicing good personal hygiene, and eating a proper diet can prevent lead poisoning in children.

The effects of exposure to elevated zinc levels in drinking water are expected to be similar for children and adults. Zinc is an essential element needed by the body in small amounts and an important for developing fetuses for proper growth (14). Both a lack of zinc, as well as an excess of zinc, can be harmful to human health. The levels of zinc that must be consumed to cause adverse health effects are 10 to 15 times higher than the Recommended Daily Allowance (RDA) for zinc. If these extremely high levels are taken by mouth for a short time, stomach cramps, nausea, and vomiting may occur. If large doses are ingested for several months, anemia, damage to the pancreas, and decreased levels of high-density lipoprotein cholesterol may occur.

COMMUNITY HEALTH CONCERNS

There has been little concern from the citizens about the tailings piles and contamination. However, most residents did allow screening of their residential yard soil and drinking water wells. EPA has made bottled water available to affected residents. Some of the residents are aware that they will either be connected to a public water supply or provided with new drinking water wells.

The public comment version of the Newton County Mine Tailings Site Public Health Assessment was released for public comment on April 18, 2005, with the public comment period ending on May 18, 2005. On May 5, 2005, DHSS held a public availability session to present the public comment version of the Newton County Mine Tailings Site Public Health Assessment. At that time and during the 30-day public comment period, the public had the opportunity to ask questions or express concerns regarding the site and the public health assessment. At the public availability session, a few residents did inquire as to the status of the construction of the new water supply lines and deep aquifer wells. Those residents were referred to the representative from MDNR, who was present at the meeting to answer questions regarding the scheduling of the projects.

No additional health concerns were presented in person at the public availability session or received in the mail during the public comment period. DHSS did not receive any comments on the public comment version of the Newton County Mine Tailings Site Public Health Assessment during the public comment period.

CONCLUSIONS

The geology of the Newton County area is karst; therefore, ground water movement and migration of contamination through the ground are often unpredictable. Since 2000, bottled water has been provided to all residents who will accept it. Not all residents have accepted it. Ultimately, these residents will be provided with either an opportunity to connect to a public water system or a new deep well. Most residents will accept public water or a new well, but some may not.

Sampling results indicate that in the past, some residents of Newton County were exposed to elevated levels of lead, cadmium and/or zinc in drinking water from their private wells until bottled water was provided. Contaminant levels have been elevated for an unknown period of time in the past and the amount of exposure residents received from their potentially contaminated wells for this time period is unknown. Currently, those residents who have not accepted bottled water or yard remediation are potentially being exposed to elevated levels of lead, cadmium, and zinc in their ground water and possibly lead in their residential yard soils. As a result, the Newton County site has been classified as a public health hazard for past and present exposures. A site that is classified as a public health hazard poses a health risk as a result of long-term exposures to hazardous substances.

If a resident has had their yard soil remediated and is accepting bottled water or connected to a new uncontaminated water source, the potential for exposure is eliminated. Under those circumstances, the site poses no public health hazard for future exposure. Sites where exposure to contamination is no longer occurring do not pose a public health hazard.

Because of the area's karst geology, the source areas having not been remediated, and the potential for further well contamination, there is a potential for future exposure. Also, residents that choose not to connect to the new water system or have a new well constructed could be exposed to contaminated drinking water. Therefore, the Newton County site could potentially pose a public health hazard to these residents for future exposure.

These classifications are based on the following conclusions:

1. It has been determined through well testing that lead and cadmium contamination is present in the ground water at levels significantly above the current health based drinking water limits.

2. Some residential yards in all the subdistricts and Spring City area were found to have lead levels above site-specific removal action limits (500 mg/kg and 2,500 mg/kg).

3. High levels of contaminants are present at the source areas that have yet to be remediated; therefore, exposure may occur to remediation workers, trespassers, and others that occupy or work around the source areas, such as the mining, milling, smelting and tailings areas. Exposure could also occur if the area is developed or used for other purposes before it is completely remediated.

RECOMMENDATIONS

1. EPA should continue to provide bottled water to residents in order to eliminate exposure to contaminated ground water at this site.

2. EPA should continue with Alternative No. 7 as outlined in the Engineering Evaluation and Cost Analysis. This alternative includes extending public water supply lines to accessible residents and drilling new deep aquifer wells for remote residences.

3. EPA/DNR should consider remediation of source areas, including the piles within Granby and the Prairie Run Tailings Pile, to mitigate further ground water, soil, and air contamination.

4. EPA/DNR should consider further testing and treatment of residential yards that have lead levels between 400 mg/kg and 800 mg/kg.

5. The Newton County Health Department should increase the number of children under six years of age that have their blood tested for lead.

6. EPA/DNR should conduct sampling of sediment, surface water, and fish in Shoal Creek to determine if elevated levels of contaminants are present at a level of health concern.

7. Residents of Newton County should only use mine waste in ways that are not likely to present a threat to human health or the environment as outlined in EPA's February 2003 Fact Sheet on Mine Waste (Appendix E).

8. EPA/DNR should remediate the areas affected by mining or milling-related activities to lessen the risk of physical hazards to workers and trespassers as a result of open mine shafts, exploratory mine shafts, or air vents.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for the Newton County 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. DHSS/ATSDR will coordinate with the appropriate agencies or stakeholders to implement the recommendations in this public health assessment.

2. DHSS/ATSDR will coordinate with the appropriate agencies to address community health concerns and questions as they arise and provide necessary community and health professional education as to the dangers of lead poisoning.

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

4. DHSS/ATSDR held a public availability session to present the public comment version of the Newton County Mine Tailings Site Public Health Assessment. At that time and during the 30-day public comment period, DHSS was available to answer questions regarding the site and the public health assessment.

PREPARERS OF THE REPORT

PREPARER:

Kristi Campbell
Environmental Specialist
Section for Environmental Public Health
Missouri Department of Health and Senior Services

REVIEWERS:

Arthur Busch
Environmental Specialist
Section for Environmental Public Health
Missouri Department of Health and Senior Services

Cherri Baysinger
Environmental Specialist
Section for Environmental Public Health
Missouri Department of Health and Senior Services

ATSDR Technical Project Officers

CDR Alan Parham
Environmental Health Scientist
Division of Health Assessment and Consultation

Roberta Erlwein
Section Chief
Environmental Health Scientist
Division of Health Assessment and Consultation

ATSDR Regional Representative

Denise Jordan-Izaguirre
Senior Regional Representative
EPA Region VII

CERTIFICATION

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

Technical Project Officer, CAT, SPAB, DHAC

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

Team Lead, CAT, SPAB, DHAC, ATSDR

REFERENCES

1. United States Environmental Protection Agency. Federal register notice. NPL site narrative for Newton County Mine Tailings. Available from: URL: http://www.epa.gov/superfund/sites/npl/nar1677.htm. 2003 September.

2. Missouri Department of Natural Resources. Site Investigation Report, Tri-State Mining, Granby, MO. 1989 October

3. CDM Federal Programs Corporation. Final SIP report for tri-state mining, Granby, Missouri. Correspondence dated June 8, 1993.

4. Black & Veatch Special Projects Corp. Engineering Evaluation/Cost Analysis, Newton County mine tailings site, Non-time critical removal support, Newton County, Missouri. 2003 August.

5. EPA. Enforcement Action Memoradum, Request for Removal Action at the Newton County Mine Tailings Site, Newton County, Missouri. 1999 May.

6. Dames & Moore. Draft Removal Site Evaluation Memorandum Diamond and Granby Subdistricts, Newton County Mine Tailings Site, Newton County, Missouri. 1998 February.

7. EPA. Hazard Ranking System Documentation Record, Newton County Mine Tailings, 2003 February.

8. U.S. Census Bureau. 2000 US Census Data, Newton County, Missouri; Available from: URL: www.census.gov.

9. ESRI Business Information Solutions. www.esribis.com.

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

11. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual. Atlanta: US Department of Health and Human Services; 1992.

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

13. National Toxicology Program. Lead (CAS No. 7439-92-1) and Lead Compounds Substance Profiles. Report on Carcinogens, Eleventh Edition; 2004.

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

15. DeLorme. Missouri Atlas & Gazetteer. 1998

17. http://www.epa.gov/region07/superfund/npl_files/newton_county_mine_tailings_sit.pdf

18. International Technology Corporation. Removal Action Plan, Residential Soil Removal, Newton County Missouri; 1999 April.

Appendix A

Figure 1. Newton County, Missouri
Figure 2. Diamond and Granby Mining Subdistricts

Appendix B

Table 1. Maximum Detected Contaminant Levels
Table 2. Exposure Pathway Analysis

Appendix C

Contaminant Dose Estimations

Appendix D

Glossary of terms.

Appendix E

EPA Region 7 Fact Sheet Mine Waste

APPENDIX A

Figures

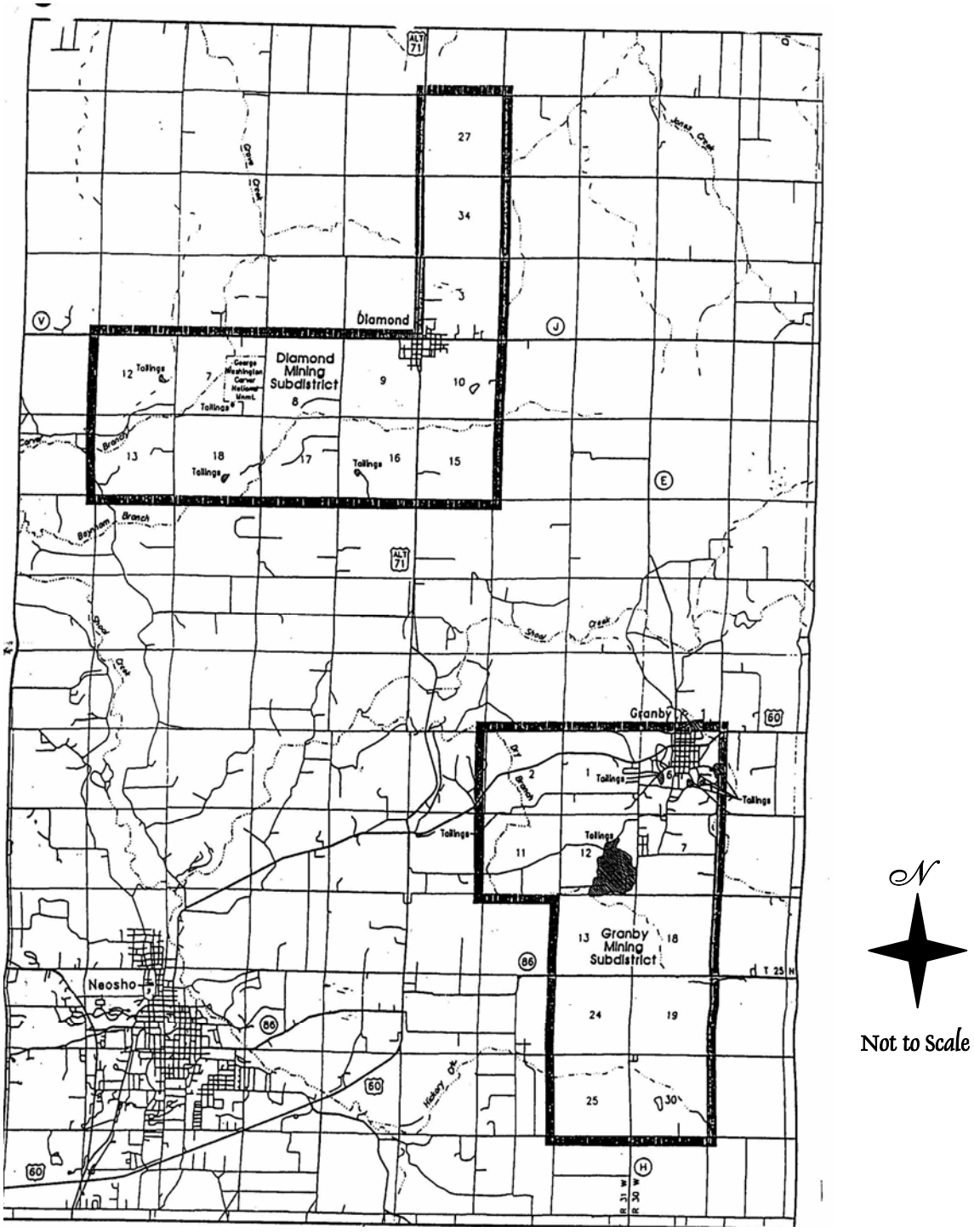
FIGURE 1

Newton County, Missouri

Source: DeLorme. Missouri Atlas & Gazetteer. 1998

FIGURE 2

Diamond and Granby Mining Subdistricts



Source: International Technology Corporation, Removal Action Plan, Residential Soil Removal, Newton County Missouri. 1999 April.

Appendix B

Tables

Table 1

Summary of Detected Contaminant Levels in Newton County, MO

Contaminant	Location	Media	Range of Values with Maximum Detected Value	# of Samples with Values above Screening Value/ # of Samples Taken	Mean Value of Elevated Sample Values	Screening Value & Source
Lead	Private Wells	Ground water	ND-1,290 ug/L	340/1,465	65 ug/L	15 ug/L EPA Drinking Water Action Level
Lead	Residential Yards	Soil	ND-33,500 mg/kg	7/395	Not known	2,500 mg/kg EPA Time Critical Removal Action Level
Lead	Tailings Pile	Tailings	23,300 mg/kg	Not Known/20	398 mg/kg (Median value)	2,500 mg/kg EPA Time Critical Removal Action Level
Lead	Tailings Pile Runoff	Surface Water	33 ug/L	1/1	NA	15 ug/L EPA Drinking Water Action Level
Lead	Air	Ambient Air	2.9 ug/m^3	1/3	NA	1.5 ug/m^3, EPA NAAQS/NESHAPS
Cadmium	Private Wells	Ground water	ND-224 ug/L	340/1,465	16 ug/L	7 ug/L (Adult) & 2 ug/L (Children) ATSDR Chronic EMEG, 5 ug/L EPA MCL
Cadmium	Tailings Pile	Tailings	196 mg/kg	Not known/20	135 mg/kg	100 mg/kg (Adult) & 10 mg/kg (Children) ATSDR Chronic EMEG, 110 mg/kg MDNR CALM
Zinc	Private Wells	Ground water	ND-11,500 ug/L	340/1,465	5,417 ug/L	10,000 ug/L (Adult) & 3,000 ug/L (Children) ATSDR Chronic EMEG, 3,000 ug/L EPA Action Level

NA = Not applicable.
EMEG=Environmental Media Evaluation Guide.
ug/m^3 = micrograms per cubic meter.
NAAQS = National ambient air quality standards.
MCL = Maximum Contaminant Level
ATSDR=Agency for Toxic Substance and Disease Registry.
ug/L = micrograms per liter.
MDNR CALM= Cleanup Levels for Missouri value for unrestricted use.
NESHAP = National emissions standard for hazardous air pollutants.
ND = None detected.
Chronic (Exposure) =exposure for more than one year (365 days).
EPA = Environmental Protection Agency

Table 2

Exposure Pathway Analysis

Pathway Name	Exposure Pathway Elements					Time
	Source	**Environmental Medium**	**Point of Exposure**	**Route of Exposure**	**Exposed Population**	
Ground water	Mine shafts, tailings and chat piles, contaminated soil	Ground water	Private drinking wells	Ingestion	Residents in Newton County	Past Present Future
Ambient air	Mine tailings	Ambient Air	Ambient Air	Inhalation	Residents in Newton County	Past Present Future
Soil	Mine shafts, tailing piles	Surface Soil	Residential yards, schools and daycare centers	Ingestion and inhalation	Residents in Newton County, especially in the Granby subdistrict	Past Present Future
Fish	Tailings piles, mine shaft	Surface Water	Residences or cookouts	Ingestion	Residents who eat fish from Shoal Creek	Past Present Future

Appendix C

Calculations

Appendix C

Contaminant Dose Estimations

Equation used for Estimating Water Ingestion Exposure Dose:

$$ID_w = \frac{C \times IR \times EF}{BW}$$

where: ID_w = Ingestion Exposure Dose [milligram per kilogram per day (mg/kg/day)]
C = Contaminant Concentration (mg/L)
IR = Ingestion Rate (default of 2 L/day for adult, 1 L/day for child)
EF = Exposure Factor [amount of time exposed (assume 100% of the time, value = 1)]
BW = Body Weight (default of 70 kg for adult and 10 kg for child)

Cadmium

Mean Value (16 ug/L or 0.016 mg/L)

Adult

$$ID_w = \frac{0.016 \text{ mg/L} \times 2 \text{ L/day} \times 1}{70 \text{ kg}}$$
ID_w = 0.00046 mg/kg/day

Child

$$ID_w = \frac{0.016 \text{ mg/L} \times 1 \text{ L/day} \times 1}{10 \text{ kg}}$$
ID_w = 0.0016 mg/kg/day

Maximum Value (224 ug/L or 0.224 mg/L)

Adult

$$ID_w = \frac{0.224 \text{ mg/L} \times 2 \text{ L/day} \times 1}{70 \text{ kg}}$$
ID_w = 0.0064 mg/kg/day

Child

$$ID_w = \frac{0.224 \text{ mg/L} \times 1 \text{ L/day} \times 1}{10 \text{ kg}}$$
ID_w = 0.0224 mg/kg/day

Minimal Risk Level (MRL) established by ATSDR for Chronic (occurring for more than one year) Oral Exposure to Cadmium is 0.0002 mg/kg/day.

Contaminant Dose Estimations

Zinc

Mean Value (5,417 ug/L or 5.417 mg/L)

Adult

$ID_w = \frac{5.417 \text{ mg/L} \times 2 \text{ L/day} \times 1}{70 \text{ kg}}$

$ID_w = 0.155$ mg/kg/day

Child

$ID_w = \frac{5.417 \text{ mg/L} \times 1 \text{ L/day} \times 1}{10 \text{ kg}}$

$ID_w = 0.5417$ mg/kg/day

Maximum Value (11,500 ug/L or 11.5 mg/L)

Adult

$ID_w = \frac{11.5 \text{ mg/L} \times 2 \text{ L/day} \times 1}{70 \text{ kg}}$

$ID_w = 0.329$ mg/kg/day

Child

$ID_w = \frac{11.5 \text{ mg/L} \times 1 \text{ L/day} \times 1}{10 \text{ kg}}$

$ID_w = 1.15$ mg/kg/day

Minimal Risk Level (MRL) established by ATSDR for Chronic(occurring for more than one year) Oral Exposure to Zinc is 0.3 mg/kg/day. The MRLs established by ATSDR for Intermediate (occurring for more than 14 days but less than one year) Oral Exposure to Zinc is 0.3 mg/kg/day.

Appendix D

Glossary of Terms and Acronyms used in the Newton County Mine Tailings Site Public Health Assessment

Appendix D

Glossary of Terms and Acronyms used in the Newton County Mine Tailings Site Public Health Assessment

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.

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

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

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.

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

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.

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).

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.

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

DHSS Department of Health and Senior Services.

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

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.

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 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.

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

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 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.

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.

Karst An area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams, and caverns.

MCL Maximum Contaminant Level The highest level of a contaminant that EPA allows in a public drinking water system. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. EPA sets MCLs at levels that are economically and technologically feasible.

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

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.

MDNR Missouri Department of Natural Resources.

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.

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

ppm parts per million

Plume An area of chemicals in a particular medium, such as air or ground water, 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 ground water.

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/Indeterminate 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 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.

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.

Removal Action An immediate action taken over the short-term to address a release or threatened release of hazardous substances.

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

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).

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.

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.

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.

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.

Volatile Organic Compounds (VOCs) Substances containing carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen; these substances easily become vapors or gases. A significant number of the *VOCs* are commonly used as solvents (paint thinners, lacquer thinner, degreasers, and dry cleaning fluids).

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 E

Fact Sheet

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.