HEALTH CONSULTATION

GRASSROOTS SMELTER/SALINE VALLEY
CONSERVATION AREA CAMPGROUND

MILLER COUNTY, MISSOURI

April 18, 2014

Prepared By:

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

SUMMARY

Introduction The top priority for the Missouri Department of Health and Senior Services (DHSS) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR), in evaluating the public health impact of the Grassroots Smelter/Saline Valley Conservation Area Campground is to provide visitors to the site the best information possible to safeguard their health.

The Saline Valley Conservation Area Campground has been found to be contaminated with elevated levels of lead contamination at certain camping sites from past smeltering activities. Another concern at the site is the physical hazards that exist in the area where active mining took place on the hill to the north.

Conclusions DHSS has reached two conclusions in this health consultation.

Conclusion 1 Ingesting (swallowing) and/or inhaling (breathing) [a minor contribution] of lead contaminated soil or dust found at elevated levels in certain campsites at The Saline Valley Conservation Area Campground could harm individuals' health and present a public health hazard. This conclusion applies to past, present, and future exposure to lead at the site.

Basis for Decision

Elevated levels of lead contamination from past lead smeltering activities is present in surface and subsurface soils in certain camp sites where visitors may spend a limited amount of time but could still be exposed to the more bioavailable smeltered form of lead. Individuals, especially children, can be exposed to this contaminated soil directly by accidentally ingesting the soil during different activities at the campsites. Although not as major of a route as ingestion, individuals can also be exposed by inhalation to contaminated dust at the campsite. When this soil or dust is stirred up and becomes airborne, individuals, especially children, may breathe it in and then clear it from their lungs and swallow it.

Conclusion 2 Physical hazards exist in the former area of mining activity that could be considered a public health hazard where someone walking through the area could fall into openings and seriously injure themselves.

Basis for Decision

Physical hazards from covered and open mine openings, hand dug pits, crevices, drop-offs, and lead contaminated mine spoils exist in the former area of mining activities located on the hill north of the campground with no warning information to inform visitors of the hazards. Anyone walking through the area could accidentally fall into the openings or fall through the covered openings injuring or trapping themselves.

Next Steps To protect visitors:

1. DHSS will offer their assistance to MDNR and/or stakeholders to alleviate the potential for lead exposure at this site.

2. DHSS will provide assistance to MDNR and/or shareholders in developing health educational material to inform visitors of the potential exposure to lead and its possible health effects as requested.

3. DHSS will review additional exposure information/site data as it becomes available and provide guidance regarding possible health risk if necessary.

STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

The Missouri Department of Health and Senior Services (DHSS) prepared this health consultation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). This health consultation was requested by the Missouri Department of Natural Resources (MDNR) to evaluate the exposure potential and associated health effects from possible lead exposure to visitors and campers of the former Grassroots Lead Smelter/Saline Valley Conservation Area. MDNR requested a health consultation from DHSS to determine if the site represented a health hazard.

Background

The former Grassroots Smelter Site, now part of the 4,783 acre Missouri Department of Conservation (MDC) Saline Valley Conservation Area is located approximately 4.5 miles south of Eugene, Missouri on Missouri Highway 17 to the turnoff for Saline Road. The site is located approximately one mile east on Saline Road near the junction of the gravel roads Saline Road, Woods Road, and Central Hill Road in Miller County, Missouri (See Figure 1). Access can also be gained from the western end of the conservation area from Missouri State Route M out of Eldon, Missouri to Central Hill Road to the camping and surrounding area. (1,2)

The site consists of a small area where lead was mined, milled, and smeltered in the early 1870s. Barite and calcite were also mined at the site. The site includes an upland area where the hand dug mine pits are located, a pond that the upland area drains into, and a primitive camping area. The small pond is open to fishing. The MDC primitive camping area lies to the south and down gradient of the mining area and pond, in the area where a former lead smelter is suspected of being located. No visual evidence of the smelter remains today. (1,2,3) See Figures 2, 3, and 4 for views of the area.

MDNR investigated the site under an Environmental Protection Agency (EPA) grant to identify and document contaminated sites of lead-mine scarred land and provide environmental data that may be used in planning future use or redevelopment of mine-scarred lands in Missouri (1).

The MDNR investigation found that lead had been mined in the clayey overburden along the hillside slopes and in a main crevice crossing the crest of the hillside. A number of mine openings, hand dug pits, drop offs, open crevices, and piles of mine spoils remain today, and can present a physical hazard. During its time of operation an estimated 500,000 pounds of lead was produced. Most of the lead ore was transported by horse-drawn wagon to the smelter located approximately 1,000 feet south of the hilltop. (1,3)

On April 20, 2011, MDNR staff met with personnel from MDC, DHSS, and MDNR Geology and Land Survey to conduct a site reconnaissance to gather data for a Phase I Brownfields Targeted Assessment Report. Staff walked through the worked mined areas on the forested hillside and noted the areas of past mining had numerous hand-dug shafts, open crevices, drop offs, mine openings and mine spoils. Other suspected openings were covered with rusted roofing sheets (See Figure 5). Measurements of lead concentrations in different site soils were detected with an X-ray fluorescence (XRF) analyzer with lead levels ranging from 154 parts per million (ppm) to 475 ppm on the northwest hilltop. In a crevice on the south side of the hill, lead levels ranged from 1,473 ppm to 4,025 ppm. (1)

The group then went back to the campground and took XRF measurements of the soil in the camping area. The camping area consists of six campsites with an additional one planned. A limestone/gravel covered drive runs between the north and south campsites to a pit toilet (See Figure 3). The campsites are used mostly during the warm summer months and during active hunting seasons, with infrequent winter use. The campsites consist of small mowed area of grass usually with tree cover, a hard surface limestone/gravel drive, and a fire ring. Surface soil readings were taken with an XRF at the different campsites with a few subsurface readings taken from areas where surface lead levels read high. Levels of lead were detected in campsites 4, 5, and 6 north of the gravel drive, while more elevated levels of lead were detected in surface and subsurface samples at campsites 1 and 2 south of the gravel drive. Surface and subsurface soil samples for lead ranged from non-detect to 350 ppm in campsites 4, 5, and 6 and from non-detect to 736 ppm in the campsites 1, 2, and 3. It was reported that the XRF analyzer was reading low and that the readings should be considered low estimates of actual lead levels. (1)

To obtain additional data for a Phase II Brownfield Targeted Assessment Sampling and Analysis Report, MDNR personnel conducted additional sampling of the site on November 30, 2011. Soil samples were taken from the campsite areas using the incremental composite sampling (ICS) method (combined multiple samples of an area). Surface soil samples (0 to 2 inches) were taken of the individual campsites. For the two campsites that had shown an elevated level of lead in the Phase I reconnaissance sampling, samples were also collected from the 2 to 4 inch depth. Two background surface soil samples (0 to 2 inches) were taken in the grassy field west of the campground (See Figure 2 and 3 for the location of the different areas and the campsites). Collected soil samples were dried and sieved to obtain the smaller particle size that would be most bioavailable to humans.

Lead levels for the three campsites (4, 5, and 6) north of the driveway ranged from 186 ppm to 455 ppm at the 0 to 2 inch depth. Samples of campsites south of the driveways exhibited greater variability, with campsites 1 and 2 having the highest lead levels at the 0 to 2 inch and 2 to 4 inch depth. See Table 1 for soil sampling results of the camping area. See Figure 3 for a location of the various camp sites.

Table 1
Range and Average Lead Levels in Soil at Saline Valley Camp Sites in parts per million (ppm) from November 30, 2011 MDNR ICS sampling

Campsite Number	Depth	Lead Level Range	Average Lead Level
Campsite 1	0-2 inches 2-4 inches	1,181 – 1,434 ppm 1,585 – 1,811 ppm	**1,316 ppm** **1,723 ppm**
Campsite 2	0-2 inches 2-4 inches	2,041 – 2,696 ppm 3,442 – 3,692 ppm	**2,330 ppm** **3,571 ppm**
Campsite 3	0-2 inches	102 –112 ppm	**105 ppm**
Campsite 4	0-2 inches	421 – 455 ppm	**444 ppm**
Campsite 5	0-2 inches	286 – 353 ppm	**310 ppm**
Campsite 6	0-2 inches	186 – 194 ppm	**189 ppm**
Future Campsite	0-2 inches	126 –139 ppm	**134 ppm**
Background from Field Sample # 1	0-2 inches	40 – 45 ppm	**42 ppm**
Background from Field Sample # 2	0-2 inches	27 – 36 ppm	**32 ppm**

MDNR = Missouri Department of Natural Resources
ICS = Incremental Composite Sampling
See Discussion Section for more details on DHSS recommended lead levels.

To determine if lead had leached from the mining area on the hillside into the pond, five ICS samples were taken from sediment (0-4 inches) across the pond. Lead levels in the sediment samples ranged from 152 ppm to 230 ppm. Water samples from the middle of the pond showed non-detect for dissolved lead and 0.78 parts per billion (ppb) for total lead. EPA Lead Action Level for public drinking water is 15 ppb.

On January 30, 2012, DHSS personnel conducted a site visit of the Saline Valley campground to inspect conditions at the site and determine the possibility that visitors/campers could come into contact with and be exposed to the lead contaminated soil. During the visit, the campground was deserted and only a lone visitor was fishing at the pond. The six campsites were primitive with only a gravel parking area, fireplace ring, and a grassy area next to the drive under some native trees. Only grass and a few trees were noted on the future campsite. There was a decent grass cover in the camping area which had been mowed. The field had a good grass cover and looked like it had been cut for hay. The remaining area was forested and left in its natural state. This forested and surrounding area could be an area where visitors could pick native plants/fungus (e.g. mushrooms) for consumption. An enclosed pit toilet is located at the western end of the driveway. See Figure 3 and 4 for a view of the camping area. During

a walking survey of the campground and surrounding area, no remnants of a smelting area were found.

DISCUSSION

This section addresses the pathways by which visitors to the former Grassroots Smelter/Saline Valley Conservation Area Campground site may have been or are being exposed to the lead contamination at the site.

When a chemical is released into the environment, the release does not necessarily lead to exposure. Exposure only occurs when a chemical comes into contact with and enters the body. For a chemical to pose a health risk, a completed exposure pathway must exist. ATSDR has determined that an exposure pathway consists of five components. At the former Grassroots Smelter/Saline Valley Conservation Area Campground site they consist of:

1. **Contaminant source –** lead contaminated soil.
2. **Environmental medium and transport** – soil, air, dust.
3. **Point of exposure** – areas where exposure to lead contamination is taking place (campsites, pond, and hilltop area).
4. **Route of exposure** – ingestion and inhalation.
5. **Receptor population** – those that ingest and/or inhale lead contamination (campers, fishers, and hikers).

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. To determine whether completed exposure pathways exist at the site, DHSS conducted an analysis of exposure pathways. Only ingestion of contaminated soils, and to a lesser extent inhalation, are considered pathways of concern since lead is not readily absorbed through the skin.

Exposure to lead contamination at the site could occur if lead contaminated soil is handled and inadvertently ingested. Lead contaminated dust that is inhaled may also be later cleared from the lungs and swallowed. An exposed child (especially under 72 months of age) is of the greatest concern because of their high hand to mouth activity and because they are more affected by exposure to lead. Considering that the lead contamination is expected to be from lead smeltering operations, the lead will be more bioavailable for uptake. Children that are also exposed to lead from other sources or who exhibit pica behavior could be more affected by the additional exposure to lead from the site. Pica behavior is the cravings to put non-food items in their mouths or eat non-food

items, such as dirt, paint chips, etc. Expectant mothers and women of child bearing age with elevated blood-lead levels can pass lead to their unborn child and also through the mother's breast milk once the child is born. (4)

There is little specific information about the use of the conservation campground in order to determine who may be exposed, whether children frequent the area, and how long exposure may occur to the lead contamination at the site. The site is situated away from large populations in a rural secluded area in the Saline Valley Conservation Area. The campground is expected to be popular during summer weekends and hunting seasons, especially deer season.

A completed exposure pathway could potentially exist for a child playing in the contaminated soil, because children tend to have a high hand to mouth activity. High levels of lead contamination have been found in and around the campgrounds where an historical lead smelter was suspected to have existed. These campgrounds are expected to be used by the public, including children, on an infrequent and short-term basis.

Exposure to the elevated levels of lead on the hillside where the past mining occurred is less likely than in the camping area. This area is wooded, hilly, and the ground is mostly covered with leaves and is expected to be used infrequently, except while traversing through the area on foot to access a hunting area (animals/plants). Another concern in this area is the physical hazards from open pits and drop-offs, some of which are covered with tin sheeting or debris but could easily give way under weight.

Consumption of the wild edible plants could also be a route of exposure to lead because some plants take up and accumulate lead in roots, shoots, and leaves. Lead contaminated soil may also stick to the edible portions of plants. The amount of lead exposure from the plants would depend on how well they were washed, how much lead the plants had accumulated, and frequency of consumption. However, because the area of contamination around the suspected historical smelter is relatively small, it is unlikely that a significant amount of plants could be gathered from this area. This pathway is deemed insignificant and is therefore not further evaluated.

The new CDC reference value for blood lead is 5 micrograms of lead per deciliter of blood (µg/dL) in place of the previous 10 µg/dL level of concern, though the agency and its scientific advisors emphasize that research shows no safe level of blood lead. The CDC reference level is used to identify children with blood lead levels much higher than most other children. To determine risks posed by lead in the environment, human health risk assessors use EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model to predict environmental exposures to lead that could result in a significant number of children developing blood lead levels above a reference level. For many years, CDC's level of concern was 10 µg/dL for children. Using 10 µg/dL for children produces a model result of 400 parts per million (ppm) lead in soil. This level of 400 ppm lead in soil has been studied and is generally accepted as a soil lead concentration in which some action should be taken. While CDC recently changed to a reference level of 5 µg/dL,

there has not been enough time for studies to determine if it is appropriate to lower the recommended action level for soil below 400 ppm lead.

To determine a level of lead in the soil at this site that is not likely to have a potential health impact on campers/visitors (especially children) to the camping area from infrequent and short term exposure, DHSS calculated a lead soil value using EPA's IEUBK model. The IEUBK model for lead in children is used to predict the risk of elevated blood-lead levels in children (under the age of seven) that are exposed to environmental lead from many sources. The model also predicts the risk (e.g. probability) that a typical child, exposed to specific media lead concentrations, will have a lead level greater or equal to 10 µg/dL. A number of assumptions were made in the model including that the child would be exposed to the highest average lead level found in the campsites for one and two days per week and then to the average background lead level for the rest of the week. Indoor lead dust levels were assumed that campsite soils/dust would be transported back to the residence and both site and offsite soils/dust would increase indoor soil concentrations at the residence. These assumptions are considered conservative, or health-protective. The result of the IEUBK calculations is a level of 418 ppm. The calculations can be found in the appendix under Table 2.

The U.S. Environmental Protection Agency's (EPA) *Superfund Lead-Contaminated Residential Sites Handbook* (EPA, 2003) lays out the minimum considerations for addressing lead-contaminated residential sites and is intended to promote consistency in characterization and cleanup, while retaining the flexibility needed to respond to different sites and communities to ensure success of the remedy and provide long-term protection of human health. The handbook lays out a tiered screening process for determining cleanup levels and remedial response actions and utilizes as screening criteria the soil-lead hazard of 400 ppm for bare soil in play areas and 1,200 ppm for bare soil in non-play areas. These levels were established in the Toxic Substances Control Act, TSCA §403 Soil Hazard Rule which applies only to residential real property or property of a child-occupied facility. However, residential properties are expanded upon and defined in the handbook as any area with high accessibility to sensitive populations, and includes properties containing single-and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, community centers, playgrounds, parks, green ways, and any other areas where children may be exposed to site-related contaminated media. (5)

Considering the new CDC reference value for blood-lead levels in children, and that children's exposure to lead at this site is expected to be infrequent and short term, DHSS recommends that EPA's health-protective soil cleanup levels of 400 ppm be incorporated for any areas with high accessibility to children and 1,200 ppm for areas where exposure potential is limited. Specifically, DHSS recommends that the health-protective soil cleanup goal of 400 ppm be utilized for the camping areas and other areas with high exposure potential for children. The soil cleanup goal of 1,200 may be utilized for the remainder of the site where exposure potential is minimal, such as the wooded areas.

TOXICOLOGICAL EVALUATION

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 contaminants causing cancer are evaluated in this section.

Lead

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. 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 (4). Paint containing lead may still be present in older homes and becomes more available for uptake into the body if it is deteriorated or flaking.

The pathways of concern for lead exposure are ingestion and to a lesser extent inhalation. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure**.** The correlation between lead-contaminated soil and blood lead level are influenced by many factors, including access to soil, levels of lead in 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 route of exposure (6).

Children are more sensitive to the effects of lead than adults. The Centers for Disease Control and Prevention (CDC) considers lead poisoning the number one preventable health problem facing children (4). No safe blood-lead level (BLL) in children has been determined. Until recently, children were identified as having a blood-lead level of concern if the test result was 10 µg/dL or greater of lead in the blood. Studies have shown that adverse health effects can occur in children with blood-lead levels below 10 µg/dL (4). CDC recently began using a reference value of 5 µg/dL, the 97.5^{th} percentile of blood lead in a representative sample of children in the U.S. 1-5 years of age; in other words, 2.5% of these children had blood lead levels at or above 5 µg/dL. Children identified with BLL greater than or equal to 5 µg/dL should prompt public health actions as recommended in the report of the Advisory Committee on Childhood Lead Poisoning Prevention: *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention* dated January 4, 2012 (7). Health effects of lead poisoning at these BLLs include decreased attention span, hyperactivity, and lower IQ scores. 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 is adversely affected by lead. (4)

Lead has no nutritional value and has its greatest effect on the nervous system, especially in children. An unborn child can also be exposed to lead if their mothers have lead levels

in their bodies. This *in utero* exposure can results in problems such as premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children. Young children can also be exposed to lead in their mother's breast milk if she has elevated lead levels in her system (4).

The biologic fate of inorganic lead in the human body is well known. Inorganic lead is not metabolized but is directly absorbed, distributed, and excreted. Once in the blood, lead is distributed 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 (4).

The lead concentrations found in the soil in certain areas of the Saline Valley Conservation Area, especially in the camping area, exceed the site-specific values calculated by DHSS as well as the EPA action levels. Visitors, especially children, who are exposed to the lead contaminated soil in these areas, may therefore be at risk.

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 (8).

The EPA considers lead to be a probable human carcinogen and the National Toxicology Program (NTP) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens based on limited studies (9). There have been no studies linking residential, or in this case recreational, ingestion or inhalation of lead contaminated soil to increased cancer risks. The primary health concern for lead at the Grassroots Smelter site is not cancer, but lead's effect on the nervous system, especially for children less than 72 months of age.

Children's Health

In general, children are more likely than adults to be exposed to contaminants in soil and water. In their daily activities, children have a tendency for frequent hand-to-mouth contact and often introduce non-food items into their mouths. Children who exhibit pica behavior are even more likely to consume larger amounts of non-food items. A pica child has a craving to put non-food items in their mouths or eat non-food items, such as dirt, paint chips, etc. Because children are smaller, their bodies/organ systems are still developing, and they typically absorb more of the contaminants, so it usually takes less of a contaminant to cause adverse health effects in children than adults. (4)

Children are more susceptible to lead poisoning than adults, and children are also 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.

They can also be exposed to lead through breast milk if the mother has elevated levels of lead in her system. Also, compared to adults, a larger proportion of the amount of lead swallowed will enter the blood in children (4). While about 99% of the lead entering the body of an adult will leave as waste within a few weeks, only about 32% of lead entering the body of a child will leave as waste (4). All of these factors result in children being more affected by lead than adults when they have similar lead concentrations in their environment.

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. Unborn children can also be exposed to lead through their mothers if their bodies contain lead and are at risk of premature birth, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (4).

CDC's previously considered 10 micrograms of lead per deciliter (10 μg/dL) of blood-lead level as the level of concern; however, studies have shown that adverse health effects can occur in children with blood-lead levels below 10 μg/dL (4). In 2012, CDC adopted the recommendation by the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) to begin using a "reference value" that is based on the population of children aged 1-5 years in the U.S. whose blood lead levels are in the highest 2.5% of children tested. That level is currently 5 μg/dL of blood (7). Yearly blood-lead testing before a child is 72 months of age is key to determining if the child has been exposed. Eliminating exposure pathways by controlling contamination sources, practicing good personal hygiene, and eating a balanced diet high in calcium can lessen the risk of lead poisoning.

CONCLUSIONS

1. Elevated levels of lead contamination are present in surface and subsurface soils in certain camp sites that could present a public health hazard. Visitors may spend a limited amount of time but could still be exposed to the more bioavailable smeltered form of lead. The actual location of the historical smelter has not been determined and higher levels of lead contamination could be present at its former location.

2. Physical hazards from covered and open mine openings, hand dug pits, crevices, and lead contaminated mine spoils exist in the former area of mining activities located on the hill north of the campground could present a public health hazard. No warnings of the physical hazards are present and someone could accidently fall into or fall through the covered opening and injure or trap themselves.

RECOMMENDATIONS

1. DHSS recommends that actions should be taken to reduce the potential for exposure to the high concentrations of lead in surface and subsurface soil at certain campsites.

2. DHSS recommends that warning signs should be erected notifying visitors/hunters about the lead and physical hazards that exist in the area.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for Grassroots Smelter/Saline Valley Conservation Area contains an explanation of the actions to be taken by DHSS and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, or other stakeholders at the site:

1. DHSS will offer their assistance to the MDNR and other stakeholders to alleviate the potential for lead exposure at this site.

2. DHSS will provide assistance to MDNR and/or shareholders in developing health educational material to inform visitors of the potential exposure to lead and its possible health effects as requested.

3. DHSS will review additional exposure information/site data as it becomes available and provide guidance regarding possible health risk if necessary.

REPORT PREPARATION

This Health Consultation for the Grassroots Smelter/Saline Valley Conservation Area Campground was prepared by the Missouri Department of Health and Senior Services (DHSS), Bureau of Environmental Epidemiology under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. This report was supported by funds from the cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. This document has not been reviewed and cleared by ATSDR.

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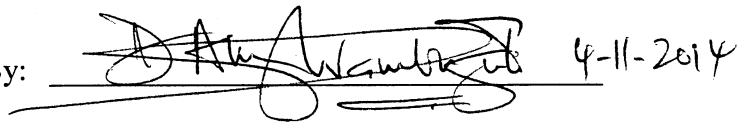
Approved By:  4-11-2014

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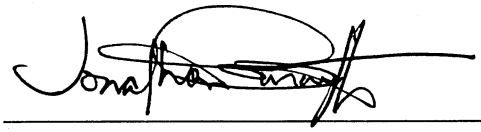
Approved By:  4/18/14

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APPENDIXES

Appendix A:

Figure 1: Saline Valley Conservation Area Site Location and Area Map
Figure 2: Saline Valley Conservation Area Campground and Vicinity
Figure 3: Saline Valley Conservation Area Campground Area
Figure 4: Saline Valley Conservation Area Campground Area Looking Northwest
Figure 5: Examples of Physical Hazards in the Area of Past Mining Activity on the Hill at Saline Valley Conservation Area
Table 2: Calculation of Recreational Child Exposure to Lead

Figure 1
Site Location and Area Map

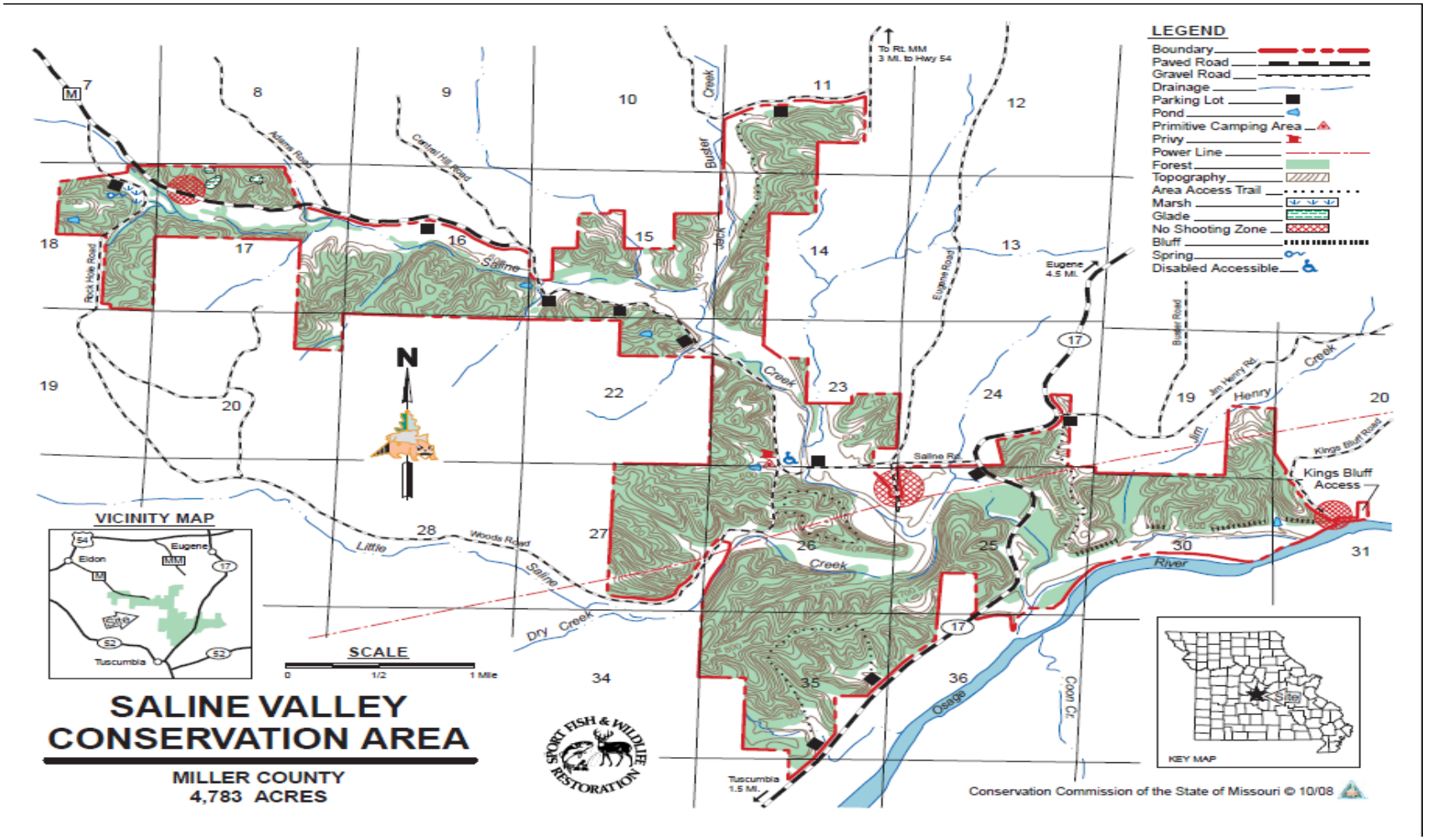
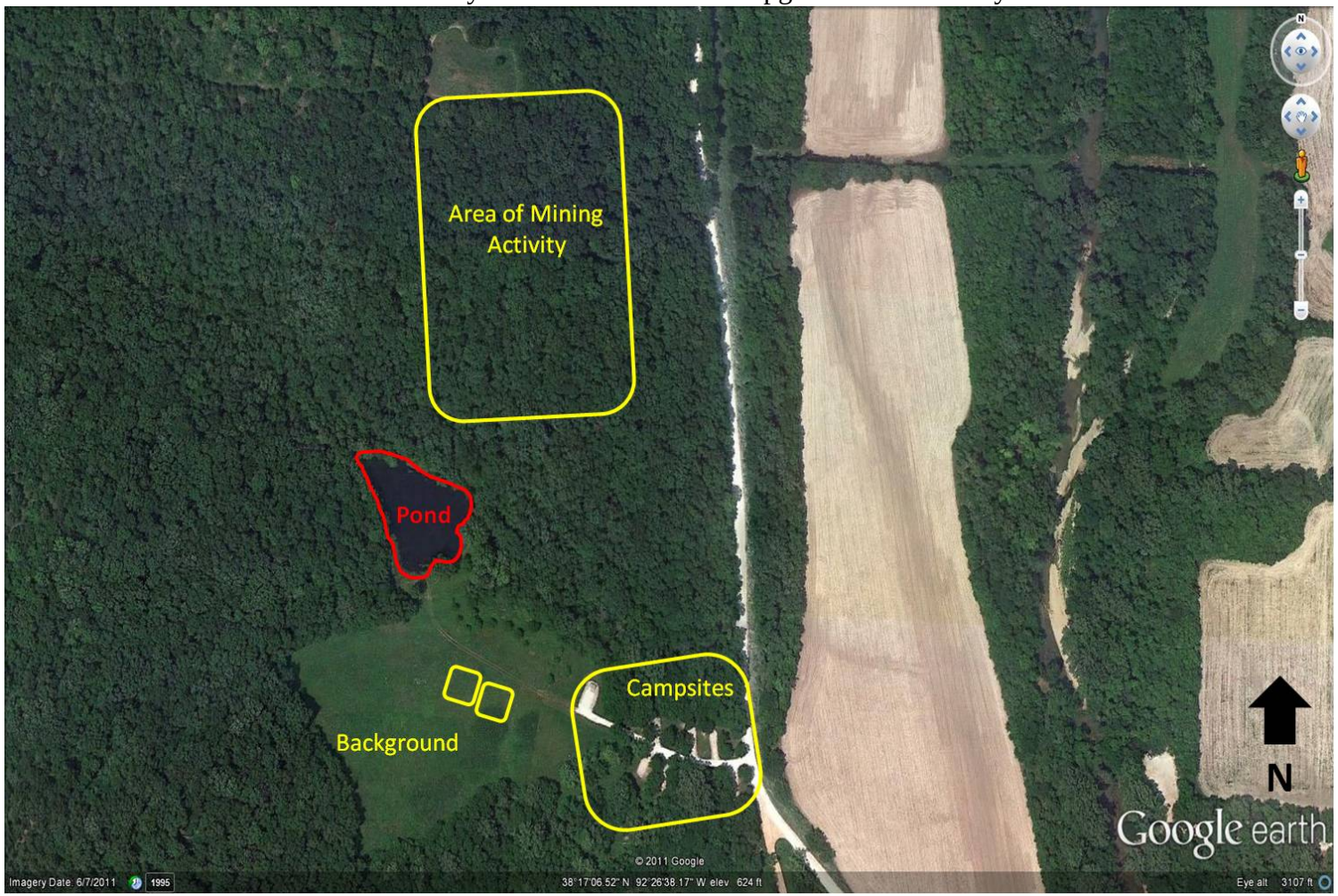


Figure 2

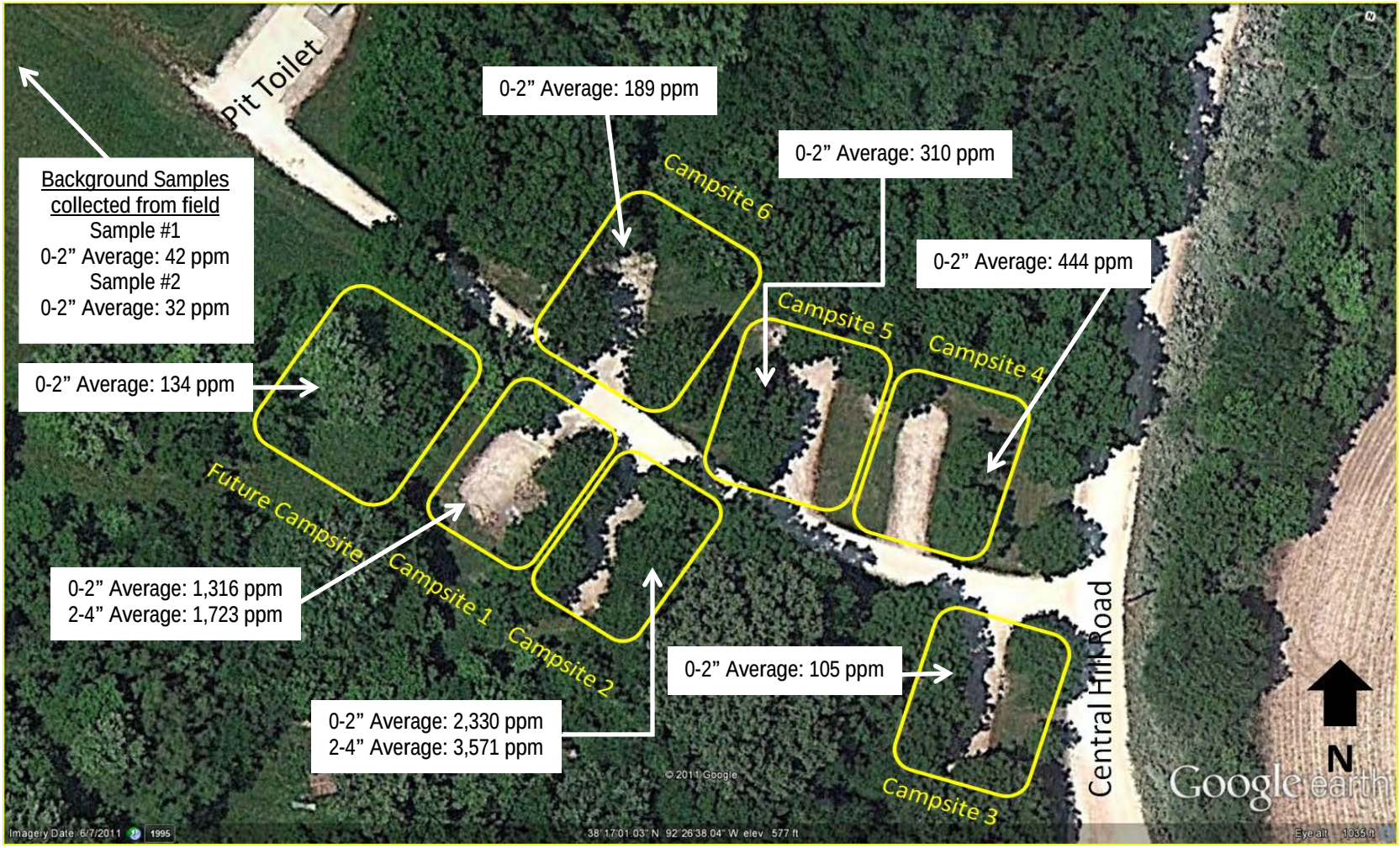
Saline Valley Conservation Area Campground and Vicinity



Source: Missouri Department of Natural Resources, Phase II Brownfield Targeted Assessment, November 30, 2011

Figure 3

Saline Valley Conservation Area Campground – Average Soil Lead Levels



Source: Modified from Missouri Department of Natural Resources, Phase II Brownfield Targeted Assessment, November 30, 2011

Figure 4

Saline Valley Conservation Area Campground Looking Northwest – January 30, 2012

Figure 5
Examples of Physical Hazards in the Area of Past Mining Activity on the Hill at
Saline Valley Conservation Area – April 20, 2011

Table 2
Calculation of Recreational Child Exposure to Lead

IEUBK Results for Recreational Child Exposure Scenario Varying Exposure Frequency

Exposure Frequency (days per week)	Soil Pb (ppm)	Indoor Dust Pb (ppm)	P_{10} (%)	Model-calculated Preliminary Remediation Goal (PRG) (ppm)
1	369	268	**3.27**	**418**
2	696	497	**20.52**	**418**

ppm = parts per million

The EPA risk reduction goal for contaminated sites is to limit the probability of a child's blood lead concentration exceeding 10 µg/dL (the P10) to 5% or less.

ASSUMPTIONS

Input parameters to the IEUBK Model for Lead in Children were default values with the exceptions noted below.

- Lead Concentrations were weighted by exposure to onsite media concentrations and assumed offsite media concentrations.
  - Soil Pb was calculated based on exposure to onsite soils (using the highest average campsite concentration) 1 and 2 days per week while the remaining days per week were assumed exposed to the site-specific background concentration of 42 ppm.
  - Indoor Dust Pb was calculated assuming soil-to-dust transfer of soils tracked in from both offsite and onsite concentrations (assumes lead-bearing soil/dust is transported back to the residence on shoes, clothing, and other items which increases indoor dust lead concentrations at the residence.

Weighted Soil Concentrations

EF_{site} (days/week)	$EF_{residence}$ (days/week)	PbS_{site}	$PbS_{residence}$	Weighted Lead Concentration Equation	PbS_w
1	6	2,330	42	$PbS_w = (EF_{site} * PbS_{site}) + (EF_{residence} * PbS_{residence})$	369
2	5	2,330	42		696

PbS_w = Weighted soil lead concentration (ppm)

PbS_{site} = Average soil lead concentration at site (ppm)

$PbS_{residence}$ = Average soil lead concentration at residence (ppm)

EF_{site} = Exposure frequency expressed as fraction of the days/week child visits the site during the exposure period

$EF_{residence}$ = Exposure frequency expressed as fraction of the days/week child does not visit the site during the exposure period, $1-EF_{site}$