RECORD OF DECISION

Historical Mining – Residential Soils
Operable Unit 1
Southwest Jefferson County Mining Site

Jefferson County, Missouri

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Superfund

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RECORD OF DECISION

DECLARATION

SITE NAME AND LOCATION

Southwest Jefferson County Mining
Historical Mining – Residential Soils
Operable Unit 01 (OU-1)
Jefferson County, Missouri
CERCLIS ID #: MON000705443

STATEMENT OF BASIS AND PURPOSE

This decision document for OU-1 presents the selected remedial action (RA) for lead-contaminated residential property soil at the Southwest Jefferson County Mining site (Site). This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Contingency Plan. This decision is based on the Administrative Record for the Site. The Administrative Record is located at the following information repositories:

De Soto Public Library 712 Main Street De Soto, Missouri 63020 Hours: Monday – Friday 9:00 a.m. to 5:00 p.m. Saturday 9:00 a.m. to 2:00 p.m.	Before October 15, 2012 EPA Region 7 901 North 5th Street Kansas City, Kansas 66101	After October 15, 2012 EPA Region 7 11201 Renner Boulevard Lenexa, Kansas 66219

The state of Missouri concurs with the Selected Remedy. State comments are presented and addressed in the attached Responsiveness Summary.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response actions selected in this Record of Decision (ROD), present a current threat to public health, welfare or the environment. Therefore, the actions selected in this ROD are necessary to protect the public health and the environment from actual or threatened releases of hazardous substances into the environment. The Site contains heavy metals, primarily lead, in soil as a result of historical lead mining and processing.

DESCRIPTION OF THE SELECTED REMEDY

The U.S. Environmental Protection Agency believes the Selected Remedy—Alternative 2, with an estimated present worth cost of $28.4 million—appropriately addresses the principal current and potential risks to human health and the environment. The Selected Remedy addresses human health risks by the remediation of lead-contaminated residential property soil. The residential properties at the Site are being addressed by this ROD to expedite cleanup of the areas that pose the greatest and most immediate threats to human health. The major components of the Selected Remedy for the residential properties across Jefferson County include the following actions:

- Excavation, backfilling and revegetation of lead-contaminated residential soil exceeding 400 parts per million (ppm) lead at an estimated 800 residential properties;

- Sampling 10 percent of properties for laboratory analysis of lead, arsenic and chromium to ensure collocated contaminants of concern that have been present in a small number of properties are remaining collocated and are being addressed through the excavation of properties with lead-contaminated soils exceeding 400 ppm;

- Health education for residents at the Site to support and raise public awareness, coordination with local health departments, distribution of vacuum cleaners and exposure prevention information, coordination with area physicians of local families and implementation of special projects to increase awareness of how local citizens can protect themselves from heavy metal health risks; and

- Institutional controls (ICs), which may include collaboration with interested citizens and local, county, state and federal government officials to discuss and evaluate future ICs to safeguard future residential development and protect remediated residential properties from lead recontamination. These ICs may include but are not limited to registry of properties with Jefferson County Health Department, building permitting, deed restrictions and environmental covenants.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state laws that are legally applicable or relevant and appropriate requirements for the RA, and is cost effective. The Selected Remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable but does not use treatment as a principal element because of the lack of demonstrated, effective treatment alternatives. Because the Selected Remedy will result in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the RA to ensure that the remedy is or will be protective of human health and the environment.

Cecilia Tapia

Cecilia Tapia, Director
Superfund Division, EPA Region 7

Date 9/12/12

RECORD OF DECISION
Historical Mining – Residential Soils
Operable Unit 1
Southwest Jefferson County Mining Site
Jefferson County, Missouri

SITE NAME, LOCATION AND DESCRIPTION

This Record of Decision (ROD) for the Southwest Jefferson County Mining site (Site), Operable Unit 1 (OU-1), concerns upcoming remedial actions (RAs) to address lead surface soil contamination at residential yards and public areas across the Site. It provides background information, summarizes recent information driving the Selected Remedy, identifies the Selected Remedy for cleanup and its rationale, and summarizes public review and comment on the Selected Remedy.

This ROD is a document that the U.S. Environmental Protection Agency as lead agency for the Site is required to issue to fulfill the statutory and regulatory requirements found in section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 U.S.C. § 9617, as amended, and in the National Contingency Plan (NCP), 40 CFR § 300.430(f)(4), respectively. The support agency is the Missouri Department of Natural Resources (MDNR). The EPA plans to conduct the RA as federal fund-lead work.

The Site covers the entirety of Jefferson County, Missouri, excluding the Herculaneum site, and, as a mining site, includes any media impacted by heavy metals mainly related to historical mining and milling activities. Jefferson County is located approximately 30 miles south of St. Louis, in southeastern Missouri within the Old Lead Belt where heavy metal mining has occurred since the early 1700s and industrial mining has occurred since the 1800s. Mining activities began in the early 1800s in southern Jefferson County. The Site consists of residential properties and child high impact areas located within the Site boundaries shown in Figure 1 that have been impacted by past mining practices and the migration of the resulting mine waste. The Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) identification number is MON000705443. A citizen can use the CERCLIS number on the EPA's website to obtain information on the Site. A glossary of common Superfund terms is included at the end of this document.

This ROD highlights key information from the Remedial Investigation (RI), Baseline Human Health Risk Assessment (HHRA), Feasibility Study (FS) and Proposed Plan recently released for the Site. These and other documents are available for additional information regarding the upcoming RA in the Site Administrative Record (AR) located at the De Soto Public Library or the EPA Region 7 office at the following addresses:

De Soto Public Library 712 Main Street De Soto, Missouri 63020 Hours: Monday – Friday 9:00 a.m. to 5:00 p.m. Saturday 9:00 a.m. to 2:00 p.m.	Before October 15, 2012 EPA Region 7 901 North 5th Street Kansas City, Kansas 66101	After October 15, 2012 EPA Region 7 11201 Renner Boulevard Lenexa, KS 66219

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Activities leading to current problems: Soil and/or groundwater contamination by lead and other mining-related metals at the Site is most likely the result of long-term, heavy-metal mining at the Site. Mining activities began in the early 1800s in southern Jefferson County where the Cambrian dolomite source rock is exposed along the Big River and other major streams. The first production operation was a lead shot tower erected in 1809 in the southern part of Herculaneum. Two mines were in operation as early as 1818: Gray's Mine was located on the Big River and McKane's Mine was located on Dry Creek. Many other mines were opened in the 1830s and 1840s for the production of lead, zinc and barium (tiff). By 1855, three smelters were operating in Jefferson County including Valles Mines, Mammoth Mines and Sandy Mines. Historical records indicate that over three million pounds of lead were shipped out of Jefferson County annually during this time period, making it one of the leading lead producers. Past tiff producers in Jefferson County included Dresser Minerals, General Barite Company, De Soto Mining Company and Scott & Whaley. Dresser Minerals was the largest producer of barium, and, according to local residents, moved its operations overseas in the 1970s. Historical records indicate the earliest tiff mines started operating in the 1830s and ceased around 1975.

Chat deposits include mining waste rejected in the lead milling operations and consist of sand- to gravel-sized material resulting from the crushing, grinding and dry separation of the ore material that accompanied lead mining. Tailings deposits include sand- and silt-sized material resulting from the wet washing or flotation separation of the ore material. The mine waste, including chat and tailings, contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These mine wastes have contaminated soil, sediment, surface water and groundwater. Mine waste also has been transported by the Big River and manually relocated to other areas throughout Jefferson County. It has also been reported that mine waste has been used on residential properties for fill material, topsoil, private driveways and as aggregate for road construction.

Federal, state and local site investigations, and removal or remedial actions: In March 2007, an EPA contractor, Tetra Tech, completed a Pre-CERCLIS Site Screening Assessment (SSA) of the Site. As part of the SSA, a reconnaissance was conducted at 252 potential mining sites in Jefferson County identified by the Inventory of Mines, Occurrences, and Prospects database. Of the nine source areas sampled, three contained concentrations of lead greater than 1,200 ppm,

with values ranging from 1,447 ppm to 7,070 ppm. Three other source areas contained concentrations of lead ranging from 442 ppm to 1,070 ppm. Five of the six source areas with elevated lead concentrations are located on residential properties.

X-Ray Fluorescence Spectrometer (XRF) screening of the residential yard soil samples indicated a significant impact on environmental media from historical mining activities. Of the 125 residential and school yards sampled during the pre-CERCLIS SSA, nine of the samples contained concentrations of lead in the soils greater than 1,200 ppm, and 21 of the soil samples contained concentrations of lead greater than or equal to 400 ppm. Sampling data from the school property did not show elevated levels of metals associated with mining operations in the area.

A total of 106 private drinking water wells were sampled as part of the pre-CERCLIS SSA. Analytical results indicated that 13 of the wells contained metals at significantly elevated concentrations. Twelve of the wells contained concentrations of lead greater than the Safe Drinking Water Act action level of 15 micrograms per liter (µg/l). Lead concentrations ranged from 15.7 µg/l to 71.8 µg/l. Cadmium was identified at a concentration of 5.7µg/l in one well, which exceeds the Maximum Contaminant Level (MCL) of 5 µg/l.

MDNR conducted an integrated Preliminary Assessment/Site Inspection/Removal Assessment (PA/SI/RA) at the Valles Mines Company site (MON000704446) in the extreme southern part of Jefferson County, Missouri, from January to May 2004. The analytical results indicated a release of mining-related contamination from the old smelter site to surface water and sediment, but limited sampling did not document a release to groundwater. In addition, according to the XRF screening, two of the residential properties contained concentrations of lead exceeding the proposed remedial action level (RAL) of 400 ppm. This area is currently assigned a distinct OU.

In 2008, the EPA conducted a PA/SI which provided the following results: Arsenic and lead were identified in residential groundwater at concentrations that exceed health-based benchmarks, lead in residential soils and groundwater appears attributable to past mining activities and the source of the arsenic contamination is unidentified but is likely naturally occurring or from treated wood or pesticides. Data collected during previous sampling events indicate that residents could be exposed to contaminated soil and groundwater; therefore, additional investigations were recommended to further characterize and delineate the extent of contaminated soil and groundwater. Limited surface water and sediment sampling were conducted as part of this SI to characterize this migration pathway. Results obtained suggested a release to Big River, which contains wetland areas and is designated as a fishery by the State. Further characterization of this pathway was recommended to determine the extent of contamination and the source(s) of the elevated lead levels. The characterization of the surface water pathway will be completed under OU-4.

The Site was proposed for National Priorities List (NPL) listing on April 9, 2009, and was listed on the NPL on September 23, 2009.

In 2010, the EPA began a Remedial Investigation/Feasibility Study (RI/FS), characterizing the nature and extent of risk posed by the mining-related contamination and evaluating the potential remedy options. This RI incorporated investigation activities for OU-1, OU-2, OU-3 and OU-5.

OUs are described in the Scope and Role of the Response Action section of this document. The EPA completed the RI in May 2012 and the FS in June 2012. The goal of the RI/FS was to gather information sufficient to support an informed risk-management decision regarding which remedy appears to be most appropriate for the Site. Results of the RI identified lead as the contaminant of concern (COC) for OU-I with an action level for soil equal to or greater than 400 ppm. The RI also identified arsenic and chromium as COCs with soil action levels of 22 ppm and 29 ppm, respectively. The arsenic and chromium are found to be collocated with the lead contamination. Remediation of the residential properties with lead greater than or equal to 400 ppm will reduce exposure to these other COCs. The FS developed the alternatives for the RA for the residential properties.

The EPA has conducted removal activities since November 2007 consisting of excavation and disposal for residential soils exceeding 1,200 ppm and child care facility soils exceeding 400 ppm. Treatment of soils was only conducted on waste failing the Toxicity Characteristic Leaching Procedure (TCLP) analysis for disposal.

To date, the EPA has performed site-wide sampling of 2,070 residential properties for soil, with 1,611 (Appendix A, Figure 2) being associated with OU-I. In OU-I, 162 properties exceeded 1,200 ppm, qualifying the property for a time-critical removal, and 409 properties have lead-soil concentrations between 400 ppm and 1,200 ppm. Time-Critical Removal Actions (TCRAs) have been completed at most properties; however, the removal action is ongoing and new properties may be identified prior to an RA taking place. Groundwater was sampled at the Site from 654 groundwater wells; 79 exceeded the action level of 15 µg/l at the wells, and 44 of those exceeded the lead action level at the primary drinking taps. Alternative water continues to be provided until the groundwater OU-5 ROD is completed. The EPA has been providing bottled water to residents of properties where lead in groundwater exceeds the lead action level of 15 µg/l.

COMMUNITY PARTICIPATION

The public was encouraged to participate in the Proposed Plan and ROD process for the lead-contaminated residential surface soil at the Site. The Proposed Plan highlighted key information from the RI Report, FS Report, HHRA and other supporting documents in the AR. Additionally, the public historically has been made aware of the environmental issues at the Site through fact sheets, public availability sessions and press releases. The EPA established a 30-day public comment period that commenced on July 5, 2012, and was advertised in the *Jefferson County Leader* to provide the community with an opportunity to submit written or oral comments on the Proposed Plan for the residential soil. A public meeting was held on July 17, 2012, at 6:30 p.m. at the Jefferson County Fairgrounds in Hillsboro, Missouri, to present the Proposed Plan to the community, accept written and oral comments and answer any questions concerning the proposed cleanup. Eight local officials and citizens attended the public meeting. A summary of the oral comments and questions received at the public meeting and the responses are provided in the attached Responsiveness Summary. The Responsiveness Summary also contains a summary of correspondence received during the public comment period and the EPA's responses to these comments.

SCOPE AND ROLE OF THE RESPONSE ACTION

The ROD for OU-1 addresses contaminated surface soil in residential properties at the Site. The Site has been divided into six OUs to organize the work into logical elements based on similar contaminated media or by potentially responsible parties (PRPs). The EPA will continue to assess the OUs that are not included in this ROD and any future RAs will be addressed in subsequent Proposed Plans and RODs. The six OUs are described in detail as follows:

OU-1 – All residential properties in Jefferson County with soil lead concentrations equal to or greater than 400 ppm that do not qualify under OU-2, OU-3, OU-6 or the Herculaneum Lead Smelter site.

OU-2 – Consists of residential properties with soil lead concentrations equal to or greater than 400 ppm identified as having soil hauled to a property by Bob Luebbers Trucking and Grading.

OU-3 – Consists of residential properties with soil lead concentrations equal to or greater than 400 ppm identified as having received soil sold by Stewart Farms.

OU-4 – Unconsolidated Mine Waste in Jefferson County including the Big River, the Big River floodplain, rail lines and historic mine areas.

OU-5 – Consists of residential properties with contaminated groundwater from mining-related activities.

OU-6 – Consists of the Valle Mines area in southern Jefferson County and northern St. Francois County. This OU has distinct site boundaries and ownership, unlike most other historic mining sites in the county.

The Selected Remedy represents the EPA's approach to address OU-1. This includes lead-contaminated surface soil present at residential properties at the Site that have been contaminated as a result of migration of metal-bearing materials from past mining practices. For the purposes of this document, the term residential properties includes properties that contain single- and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, daycare centers, playgrounds and public parks. Under the Selected Remedy, the residential properties are being addressed first by this RA to expedite cleanup of the areas that pose the greatest and most immediate threats to human health. The Selected Remedy represents the first RA for the Site and is simultaneous with OU-2 and OU-3. The selected remedy represents a continuation of the residential soil cleanup actions that have been conducted over the past several years as TCRAs. OU-2 and OU-3 are also residential soil contamination OUs and RODs have been submitted simultaneously with OU-1. The remedies for OU-1, OU-2 and OU-3 are identical. The remaining remedial response actions for the other OUs may be addressed in future actions.

The total number of residential properties with lead-contaminated soil across OU-1 that will be addressed under this RA is estimated at 800 properties. This number comes from properties with measured soil lead concentrations at or exceeding 400 ppm, combined with an estimated percentage of properties not yet characterized but expected to have soil lead concentrations

exceeding 400 ppm. The action level for lead in residential soil, 400 ppm, is based on the site-specific HHRA and assumes lead is measured in the bulk soil sample with an XRF instrument. To a lesser extent, arsenic and chromium were identified as COCs in residential soil and will have an action level of 22 ppm and 29 ppm, respectively. Figure 1 shows the general location of contaminated residential properties at the Site.

The ROD for OU-1 addresses surface soil in residential properties at the Site. Under any remedial strategy, a number of years will be required to investigate and conduct remedial actions at residential properties at the Site. The current goal is to complete the cleanup work at OU-1 by 2017, and complete all cleanup work at the Site by 2023.

SITE CHARACTERISTICS

Geographical and topographical information: The Site encompasses the entire county which is approximately 30 miles southwest of St. Louis. The Site excludes the Herculaneum Lead Smelter site (CERCLIS No. MOD006266373), which has defined boundaries. Historically, the Site's focus was on an area of approximately 166 square miles located in the southwest quarter of Jefferson County, but due to transportation of contaminated materials expanding beyond the historic Site boundary, the Site has been expanded county-wide to address this contamination. The county is bordered on the north by St. Louis County and the Meramec River, on the east by the Mississippi River, on the south by St. Genevieve and St. Francois Counties and on the west by Washington and Franklin Counties. Jefferson County encompasses 664 square miles. Site boundaries, which include the entire county except for the Herculaneum exclusion area, are delineated in Figure 1.

Topography varies considerably throughout Jefferson County. Much of the northern and southern parts of the county can be classified as rugged with greater than 20 percent slopes that exhibit narrow ridges and deep ravines. The central one-third of the county, however, consists of wider/flatter crests and shallower valleys. The highest point in the county is Vinegar Hill at 1,060 feet above mean sea level (msl) and the lowest elevation is in the Mississippi River bottom at 385 feet msl. The landscape is controlled by various geologic units that vary in bedding thickness, depositional properties and weathering characteristics. The average temperatures in Jefferson County are 32.8°F in winter and 74.9°F in summer. The average total annual precipitation is 37.75 inches, of which 45 percent usually falls from May through September. The average snowfall for Jefferson County is 18.7 inches. Prevailing winds are from the south between May and November and from the northwest the remainder of the year.

The bedrock units in Jefferson County range in age from Precambrian to Pennsylvanian age. The bedrock units consist of gently dipping to flat formations dominated by dolomite, sandstone and limestone. The Soil Survey of Jefferson County, Missouri, indicates there are six general soil associations. Three major watersheds occur in Jefferson County: the Cahokia-Joachim (United States Geological Survey [USGS] Hydrologic Unit 07141.01) located in the eastern half of the county, the Meramec (USGS Hydrologic Unit 07140102) situated in the far north and northwest portions of the county and the Big (USGS Hydrologic Unit 07130104), which encompasses the western portion of the county. Minor rivers and streams in the Cahokia-Joachim watershed drain approximately 48 percent of the county directly to the Mississippi River. Most of the larger cities in Jefferson County are located in the Cahokia-Joachim watershed including De Soto, Olympian

Village, Hillsboro and the communities along the Mississippi River. The Meramec watershed drains approximately 15 percent of Jefferson County. No major towns or cities are within the Meramec watershed in Jefferson County. The Big watershed is dominated by the Big River, which drains about 37 percent of the county. The cities of Byrnes Mill, Fletcher, Dittmer and the Raintree community are located in the Big watershed.

Type and sources of contamination: Past mining operations have left spoils in the form of tailings deposits from smelting and mineral processing operations in the Southwest Jefferson County Mining site. Additionally, contaminated tailings deposits have been identified in large quantities in the Big River channel and floodplains throughout the county. The mine waste contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These deposits have contaminated soils, sediments, surface water and groundwater. These materials have also been transported by wind and water erosion or manually relocated to other areas throughout the county.

A conceptual site model (CSM) for human exposure pathways to heavy metals resulting from mine waste at the Site is included as Figure 3. It should be noted that although the CSM covers all anticipated human exposure at the Site, this ROD is focused on addressing the highest human health threat at the Site, namely, the exposure of child residents to lead in residential property surface soil and the resulting contaminated indoor dust via incidental ingestion.

Sampling Strategy: Surface soil sampling of residential properties was performed similarly to the approach taken during previous removal actions. Approximately 2,070 residential properties at the Site have had their soil sampled and analyzed for metals, with 1,611 of those properties being associated with OU-1. The sampling generally involved dividing a residential property into quadrants and compositing five aliquots of surface soil from each quadrant. Typically, separate multi-aliquot samples were collected from gardens, child play areas, unpaved driveways and drip zones. Samples were analyzed using an XRF instrument. A small percentage of soil samples were sent off-site for laboratory confirmation analysis.

Additionally, potable water samples were collected from properties with individual wells to screen for groundwater contamination and for use in the HHRA. Historic groundwater sampling at the Site for the removal program resulted in 654 groundwater wells sampled, with 79 exceeding the lead action level of 15 μg/l at the well, and 44 of those exceeding the action level at the primary drinking tap.

In the HHRA, lead was identified as the primary COC. Other metals were identified in various media and locations as COCs in select situations. However, the ROD focuses on lead since it is the predominant COC in residential property soils at the Site. Lead is a metal and a constituent of D008 hazardous waste. It is classified by the EPA as a probable human carcinogen and is a cumulative toxicant. The organic form of lead is generally unstable and undergoes rapid conversion to inorganic lead compounds. Most forms of inorganic lead are relatively insoluble, tend to bind tightly to soil and are not very mobile.

Quantity of waste and concentrations of lead in soil: The total number of residential properties with lead-contaminated surface soil that will be addressed under this RA is estimated at 800 properties. This number comes from properties with measured lead soil concentrations greater

than 400 ppm (409 properties), and an estimated number of properties not yet sampled but that potentially could exceed 400 ppm lead in surface soil (391 properties). The action level for lead in residential surface soil, 400 ppm, is based on the site-specific HHRA and assumes lead is measured in the bulk soil sample with an XRF instrument. As shown on Figure 2, the properties already identified for cleanup are scattered across the Site.

The number of residential properties not yet sampled but that potentially could require remediation is estimated to be 391 properties and is calculated as follows. It is estimated that 1,620 residential properties for OU-1 have not yet been sampled. Historically, 45 percent of the properties actually sampled for OU-1 contained lead concentrations greater than 400 ppm. However, the historic sampling was based on areas of widespread transportation to specific areas. Future sampling and contaminated property estimates take a weighted approach to areas consisting of remaining properties requiring sampling and historic frequency of properties above the Preliminary Remediation Goal (PRG). These areas are designated as census tracts in the county, with the exception of Raintree Plantation and Sommerset Lake communities, which have exhibited a high frequency of contaminated properties and, therefore, have their own estimate calculations. Assuming the estimates generated prove valid, the total number of residential properties expected to be addressed under this RA is estimated to be 800 properties.

Based on the EPA's previous soil removal activities at the Site, an average residential property has approximately 317 yd^3 of lead-contaminated soil. Future excavation work is estimated to follow this trend within the areas outside of the Big River floodplain; however, throughout the floodplain, residential properties may require deeper excavation based on studies indicating contamination at depth. Therefore, a countywide average was increased to 330 yd^3 to estimate an average excavation of 8 inches countywide. Therefore, it is estimated that 264,000 yd^3 of residential soil is contaminated with lead above 400 ppm at the Site.

<u>Lateral and vertical extent of contamination and likelihood of migration</u>: There is considerable variability in lead concentrations found in surface soil at residential properties at the Site—from property to property and within each individual property. The actual amount of mining and smelting on any given property, as well as soil movement, would greatly affect lead soil concentrations at a residential property. Later modification of residential properties resulting from filling, grading or other activities could potentially cover or dilute lead contamination at the surface or introduce lead-contaminated soil to a property that was previously unaffected. Erosion of surface soil during rain events can relocate lead-contaminated soil. It is likely that a combination of these factors has resulted in the observed discontinuous horizontal nature of lead contamination in soil at residential properties across the county. The vertical extent of lead contamination in residential soil also varies. Humans residing at the residential properties impacted by surface soil with lead concentrations above 400 ppm are potentially exposed through the route of ingestion.

CURRENT AND POTENTIAL LAND USE

Jefferson County's estimated population, based on the 2010 Census, is 219,046, an increase of about 20,000 residents since the 2000 Census. Approximately 29,500 persons are under the age of nine. The county encompasses 664 square miles of which 657 square miles are land and 7 square miles are water. The population density, based on the estimated population of the county,

is approximately 333 persons per square mile. There are an estimated 88,396 housing units (an average of 2.48 persons per housing unit). Areas within Jefferson County are categorized as rural and urban residential, rural and urban commercial or mining related. Due to the lack of industrial expansion in the area, it is not anticipated that the land uses in this area will change substantially in the future. However, it is apparent that Jefferson County is affected by the impacts of a metropolitan population shift to the suburbs. This is supported by the substantial growth in population, the dramatic increase in the number of households in the county and the high rate of owner-occupied houses.

SUMMARY OF SITE HUMAN HEALTH RISKS

A baseline HHRA dated May 2012 (included in the AR as an RI appendix) was conducted to assess the potential risks to humans both now and in the future from site-related contaminants present in environmental media including surface soil, indoor dust and groundwater. The HHRA assumes that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the RA. The results of the risk assessment are intended to help inform risk managers and the public about potential human health risks attributable to site-related contaminants and to help determine if there is a need for action at the Site. For most heavy metals (the chemicals of potential concern [COPCs] at the Site), the HHRA follows the standard risk assessment process: (1) identification of COPCs, (2) exposure assessment, (3) toxicity assessment and (4) risk characterization. However, as explained in more detail later, the toxicity and exposure assessments, as well as the risk characterization for lead, are intrinsically included in the Integrated Exposure Uptake Biokinetic (IEUBK) model used to evaluate potential lead effects on human health. This section of the ROD summarizes the results of the HHRA.

COPCs are chemicals which exist in the environment at concentrations that might be of potential health concern to humans and which are or at least might be derived in part from site-related sources. At mining sites, the COPCs are generally metals and other inorganic chemicals that occur in mine waste. Given the large number of COPCs at the Site and the high number of media they can impact, Table 1 lists the COCs as identified by the HHRA. Further detailed information on the number of samples, their locations, the media from which they were collected, the number of detections and range of concentrations is included in the RI. In contrast, COCs are those chemicals which exist in the environment and have been shown by a risk assessment to be of concern to human health. The HHRA integrated the results of the toxicity and exposure assessments to derive the quantitative hazards that may occur due to exposure to COPCs. Ultimately in the HHRA, lead was the most frequently identified COC in soil, and is the primary risk driver for the RA described in this document. Arsenic and chromium were also identified as COCs in residential soil. Details of the HHRA risk analysis can be found in Appendix G and H of the HHRA. This ROD focuses on lead because it is the primary COC at the Site. Lead ranged from 10 to over 11,000 ppm in surface soil at approximately 1,620 residential properties.

Exposure pathways and exposed populations: Figure 3 presents the CSM which shows the variety of exposure pathways by which site-related COPCs may migrate from on-site mine waste piles, transported materials or contaminated surface soils acting as sources of contamination for other environmental media such as soil and indoor dust. The CSM also shows the various human

populations that might reasonably be exposed to heavy metals, in particular lead, in the environment. However, not all of these potential exposure pathways are likely to be of equal concern. Additionally, with respect to residents, one potential exposure scenario was not quantitatively addressed in the HHRA, and is identified as exposure to heavy metals by ingestion of garden vegetables.

With respect to lead contamination, young children (typically defined as 84 months of age or younger) residing within the Site boundaries are the population group of primary concern potentially exposed to lead at the Site. Young children are more susceptible to lead exposure than adults because they have higher contact rates with soil or dust, absorb lead more readily than adults and are more sensitive to the adverse effects of lead than are older children and adults. Thus, the most important exposure pathway for children is incidental ingestion of soil and dust. The adverse health effects of greatest concern in children are impairment of the nervous system including learning deficits, lowered intelligence and adverse effects on behavior.

The risks or potential for adverse health effects from lead are evaluated using a different approach than for most other metals. Because lead is widespread in the environment, exposure can occur by many different pathways. Thus, lead risks are based on consideration of total exposure (all pathways) rather than just site-related exposure. Because most studies of lead exposures and the resultant health effects in humans have traditionally been described in terms of blood lead level (expressed in μg/dl), lead exposures and risks are typically assessed using mathematical models. Additionally, because lead does not have nationally approved toxicological values which can be used to assess risk, standard risk assessment methods cannot be used to evaluate the health risks associated with lead contamination. Therefore, the HHRA used the EPA's IEUBK Model for Lead in Children to estimate the distribution of blood lead levels in a population of residential children exposed to lead at the Site. By using the IEUBK model to evaluate the risks posed to young children, older children and adults (including pregnant women) are also protected.

The IEUBK model can evaluate all exposure pathways and uses site-specific and default inputs (e.g. surface soil concentration, indoor dust concentration, bioavailability) to evaluate exposure from lead in surface soil, drinking water, dust and ambient air to estimate the probability that a child's blood lead level might exceed 10 μg/dl. The EPA's health protection goal is that there should be no more than a 5 percent chance of exceeding a blood lead level of 10 μg/dl in a given child or group of similarly exposed children. The Centers for Disease Control and Prevention has recently eliminated the 10 μg/dl level of concern for lead in children's blood and proposed a reference value which is tied to the highest 2.5 percent of child blood lead levels tested. The reference value is currently set at a blood lead level of 5 μg/dl and could vary over time. The EPA is considering this change and how to incorporate it in the IEUBK modeling process and its application to determining PRGs and cleanup levels. In the interim, the EPA will continue to use the IEUBK model as described above in determining PRGs.

For a residential child, the IEUBK model was run for each individual residential property because most exposure for a young child will occur at their residence using available site-specific data. First, surface soil lead concentrations, represented by concentrations in soil particles less than 250 micrometers (μm), at 72 individual unremediated residential properties were collected for use in the HHRA. Second, testing was performed to estimate the relative

bioavailability (RBA) or the amount of lead absorbed into the body from the gastrointestinal tract following ingestion of lead-contaminated soil. The results indicated that the average uptake of lead at the Site was near the IEUBK model default value. Default inputs were used for the remaining IEUBK model input parameters.

Risk results for residents from surface soil: As part of the site-specific modeling, 72 surface soil samples were collected in October 2010 to determine the site-specific bioavailability of lead. It was decided to exclude seven of the 72 samples from further consideration because the total lead concentrations in these samples were less than 100 ppm (27.5 to 99.3 ppm), which is indicative of native material, and thus, may not represent mine-waste-impacted material. The remaining 65 samples analyzed resulted in a mean absolute bioavailability (ABA) of 16 percent.

The lead ABA of soil calculated for this Site using the initial EPA Region 7 laboratory results (16 percent) was much lower than what has been found at other EPA Region 7 lead sites in the Southeast Missouri Lead Mining District. Specifically, the mean ABA values calculated for Federal Mine Tailings site (St. Joe State Park), Washington County Mining site, Madison County Mining site, and Big River Mine Tailings site were 23 percent, 26 percent, 31 percent and 34 percent, respectively. Additionally, the mean ABA for 15 soil samples collected from parks in the Jefferson County Big River floodplain—the floodplain thought to be a primary source of contamination in the Southwest Jefferson County Mining site—was 31 percent. Thus, there was considerable uncertainty regarding whether the lead bioavailability calculated for this site was accurate.

Split samples from five of the surface soil sites were submitted to the Laboratory for Environmental and Geological Studies (LEGS) at the University of Colorado in Boulder on October 3, 2011, for lead speciation (speciation concerns the identification and quantitation of specific forms of an element) and reanalysis for lead bioaccessibility. The LEGS report stated that the "...majority of lead-containing particles have lead in a form that is bioaccessible." The in vitro bioaccessible fractions in the report ranged from 0.63 to 0.72 percent, yielding a mean ABA value of 28 percent.

The EPA determined that the mean ABA of 16 percent appeared to be underestimated. In contrast, the mean bioavailability calculated by LEGS in the follow-up analyses (28 percent) seemed consistent with what was found at other Southeast Missouri mining sites; therefore, a split of the original samples was sent to the EPA's Office of Research and Development laboratory for analysis, with a final result yielding a mean ABA of 33 percent.

In past experience at Superfund sites where lead is the COC, the EPA generally selects a residential soil cleanup level within the range of 400 ppm to 1,200 ppm for lead based on the IEUBK model results and the nine-criterion evaluation included in this ROD and in accordance with the NCP. As described above, the IEUBK modeling results for the Site, along with the uncertainty provided by the datasets and multiple in vitro bioaccessibility sample results, indicate an ABA near 30 percent, the IEUBK default parameters.

The HHRA performed a qualitative analysis of arsenic in soils and concluded that arsenic is a COC for current and future exposures. Arsenic was identified as a noncancer risk driver at five properties and a cancer risk driver at one property out of the 232 properties evaluated. All of the

samples with elevated arsenic levels were collocated with lead and will not require separate RAs. Residential surface soil containing arsenic above 22 ppm will be remediated by removing up to 12 inches of soil and replacing with clean soil. This cleanup level was derived in a manner consistent with the 2010 Human Health Risk Assessment and current EPA risk assessment guidance and policy (USEPA, 2010). Given that background levels of arsenic in Jefferson County are greater than cleanup goals corresponding to cancer risks of 10^{-6} and 10^{-5}, the cleanup level is based on the noncancer hazard index of one, which is lower than a cleanup goal based on a cancer risk of 10^{-4} (USEPA, 2010). Based on qualified Site data, it is anticipated that residential soil remediation will not be necessary for properties solely due to elevated arsenic levels. The EPA has decided that at residential properties where arsenic in soil presents a risk to children and is collocated with lead at a concentration greater than 400 ppm, the EPA will address this risk under this RA. Property sampling will have 10 percent of samples sent for laboratory analysis to monitor that arsenic, when located above its PRG level, is collocated with lead-contaminated soils. Should it be determined that arsenic or chromium is found above its respective PRG and is not collocated with lead above its PRG, the EPA will take action to address each metal at its respective PRG level.

The HHRA also determined that soil at one residential property out of the 232 properties evaluated in the HHRA may present a cancer risk of 10^{-4} to children due to elevated chromium. The property containing a chromium risk was also collocated with lead. Since chromium concentrations detected at the Site are only slightly elevated and infrequent, the EPA has decided that at residential properties where chromium in soil presents a risk to children and is collocated with lead at a concentration greater than 400 ppm, the EPA will address this risk under this RA. Property sampling will have 10 percent of samples sent for laboratory analysis to monitor that chromium, when located above its PRG of 29 ppm, continues to be collocated with lead contaminated soils. In the event that chromium or arsenic is found above their respective PRGs and is not collocated with lead above its PRG, the EPA will take action to address these metals at their respective PRG levels.

Risk estimates for residents from groundwater: Groundwater is outside the scope of this OU, but this information is provided as background for the Site. Sampling of private drinking water wells commonly found at the Site detected lead concentrations exceeding the Safe Drinking Water Act's action level of 15 µg/l at over 79 residential properties at the well, and at 44 of those properties at the primary tap. In addition, other mining-related metals have been detected at levels exceeding their respective EPA MCLs in several of the private wells at the Site. Under a time-critical removal action, the EPA has provided a temporary, alternative, drinking-water source to the majority of these residences. As described above, the contaminated drinking water wells have been defined as OU-5, and the EPA intends to provide a more permanent remedy for these contaminated drinking water sources through a future RA.

Uncertainties: Quantitative evaluation of the risks to human health from environmental contamination is frequently limited by uncertainty regarding a number of key data items including concentrations in the environment, the true amount of human contact with contaminated media and the true dose-response curves for noncancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk

managers and the public to keep this in mind when interpreting the results of a HHRA. In most cases, assumptions employed in the HHRA to deal with uncertainties were intentionally conservative, thus, the risks are more likely to be overestimated rather than underestimated.

Summation of Risks

With respect to the primary COC, lead, final cleanup levels in residential property surface soil at Superfund sites are based on the IEUBK model results and the nine-criterion analysis included in this ROD in accordance with the NCP at 40 CFR § 300.430(e)(9)(iii) and incorporated by reference at 40 CFR § 300.430(f). The EPA generally selects a residential surface soil cleanup level within the range of 400 ppm to 1,200 ppm for lead, although lower or higher cleanup levels are possible based on input of site-specific data into the model. As described above, the IEUBK model results for the Site recommend a maximum lead surface soil concentration of 400 ppm (see Documentation of Significant Changes section below) to ensure that a child has less than a 5 percent probability of having a blood lead level exceeding 10 μg/dl. This soil action level is at the lower end of the typical 400 to 1,200 ppm residential risk range, and is supported by the site-specific datasets provided. Cleanup of properties with lead-contaminated soils at 400 ppm or greater is anticipated to bring the yard-wide average well below 400 ppm. The cleanup of surface soils at or above 400 ppm is anticipated to reduce child blood lead levels to meet the Remedial Action Objective (RAO) and provide a protective remedy for the community. Additional activities include health education and providing equipment and training to Site residents for high efficiency cleaning of home interiors contaminated through tracking of soil. The EPA is selecting the EPA screening level of 400 ppm lead as the residential surface soil cleanup level. Additionally, property sampling will have 10 percent of samples sent for laboratory analysis to monitor that arsenic and chromium, when identified above their respective PRGs, are collocated with lead-contaminated soils. Should it be determined that chromium or arsenic is found above its respective PRGs and is not collocated with lead above its PRG, the EPA will take action to address each metal at its respective PRG level.

This ROD only addresses human health risk at residential properties within the Site. Since this ROD only addresses human health, an Ecological Risk Assessment has not been included. An Ecological Risk Assessment identifies significant risk to ecologically sensitive areas and the natural environment, which residential soils do not include. For example, elevated lead in the sediments and surface waters of Big River poses a potential risk to aquatic biota. This and other identified risks to human health and the environment will be addressed in future cleanup decisions. OU-4 will address risk to human health and the environment from lead-impacted, nonresidential soil, surface water and sediment. OU-5 will address contaminated residential groundwater and OU-6 will address the Valles Mines area.

REMEDIAL ACTION OBJECTIVES

RAOs consist of quantitative goals for reducing human health and environmental risks and/or meeting established regulatory requirements at Superfund sites. RAOs are identified by reviewing site characterization data, risk assessments, applicable or relevant and appropriate requirements (ARARs) and other relevant site information.

Based on current Site data and evaluations of potential risk, lead was identified as being the primary COC, and arsenic to a lesser extent. The primary cause of human health risk from residential property soil at the Site is through oral ingestion. RAOs have been established for residential property surface soil at the Site and are consistent with the EPA guidance including the Superfund Lead-Contaminated Residential Sites Handbook. Thus, the RAOs for the residential property soil at the Site are to:

> **Reduce the risk of exposure of young children (children 0 to 84 months) to lead such that an individual child or group of similarly exposed children have no greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dl.**
>
> **Reduce the risk of exposure to soils containing arsenic and chromium such that levels do not exceed the carcinogenic risk of 1×10^{-4} and a noncancer hazard index of 1.**

By meeting these RAOs, unlimited use of and unrestricted exposure to Site surface soil by young children will not result in an unacceptable health risk. The RAOs are based on the understanding that current and reasonably anticipated future land use at the Site is and will be residential. Under residential land use conditions, the most susceptible receptor is a young child (age 0-84 months). Of these exposure media, the largest exposure comes from soil and dust. The final remedy for the Site will effectively control the contribution of the soil/dust exposure pathway and enable achievement of the RAOs.

No properties were identified with arsenic or chromium at levels of concern that did not also include soil lead contamination above 400 ppm. Due to the collocated nature of the other mining-related metals, the chromium and arsenic risk will be addressed through remedies addressing lead. For further information, refer to the HHRA PRG memo in the AR.

DESCRIPTION OF ALTERNATIVES

Description of Remedy Components

Three alternatives were developed in the FS to meet the identified RAOs. The alternatives were developed to specifically address lead-contaminated residential surface soil. With the exception of depth of soil remediation, Alternatives 2 and 3 have common elements.

The EPA considered phosphate treatment for reducing the risk of exposure to contaminated soils during the preliminary screening of remedial alternatives for the Feasibility Study. At that time, an extended study of phosphate treatment technology at the Oronogo-Duenweg Superfund site in Jasper County, Missouri, had achieved a maximum of 40 percent reduction in bioavailability over a seven-year study period. However, the technology had not undergone any implementability testing at a residential property by the EPA. A recent review of the technology at the Omaha Lead site entitled "Evaluation of Phosphate Treatment at Residential Properties; Omaha Lead Site, Omaha, Nebraska" has indicated concern about implementability, cost effectiveness and community acceptance in a residential setting, as well as the long-term presence and monitoring of lead in the soil even if its bioavailability has been reduced.

Based on these studies and the similarity in sites, the EPA concluded that phosphate treatment of residential soils contaminated with lead would not be considered for evaluation as a remedial alternative for OU-1.

Alternative 1: No Action

The NCP at 40 CFR § 300.430(e)(6) requires that the EPA consider a no-action alternative against which other remedial alternatives can be compared. Under this alternative, no further action would be taken to monitor, control or remediate the threat of lead in residential property soil at the Site. Alternative 1 would not meet the RAOs because it would not minimize or eliminate the existing or future potential exposure at the Site.

Alternative 2: Maximum 12-Inch Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls

- Excavation and removal of surface soil above 400 ppm lead, with excavation continuing until either the underlying soil at the bottom of the excavation is less than 400 ppm lead, or to a maximum depth of 12 inches. A visual barrier will be placed at the base of 12-inch excavations where lead levels are at or exceed 1,200 ppm.

- Clean fill and topsoil replacement along with revegetation.

- Disposal of excavated soil at an EPA-approved disposal facility.

- Health education and outreach.

- Institutional Controls (ICs).

Under this alternative, residential properties with at least one quadrant surface soil sample testing greater than 400 ppm for lead will have that quadrant remediated. If the drip-zone surface soil sample from any property where a soil quadrant is being remediated also exceeds a concentration of 400 ppm lead, the property will also have the drip-zone soil remediated. Residential properties where only the drip-zone soil and no other quadrant soil exceeds 400 ppm lead will not be addressed in this action. Based on existing surface-soil sampling data and trends in that data, 800 residential properties contain or are expected to contain lead surface-soil concentrations greater than 400 ppm and will require remediation. This alternative includes the excavation and removal of lead-contaminated surface soil, backfilling the excavation with clean soil (defined as less than 100 ppm lead and passing other metals' screening levels) and revegetation.

In general, excavation will continue in depth until the underlying soil at the bottom of the excavation is less than 400 ppm lead or to a maximum depth of 12 inches below ground surface (bgs), whichever is less. If at 12 inches bgs the lead soil concentration is equal to or greater than 1,200 ppm, the EPA will place a visual barrier prior to backfilling with clean soil. An exception is existing garden areas, where the maximum depth of excavation will be 24 inches bgs. The barrier placed will be a visible plastic barrier (such as orange mesh plastic webbing) that is permeable, wide meshed, and will not affect soil hydrology or vegetation. The visual barrier will function as a visual warning that digging lower will result in exposure to soils contaminated at a

level that the EPA has determined to be a human health concern. Clean fill and topsoil will be used to replace excavated soil, returning the residential property to its original elevation and grade. After replacement of topsoil at each residential property, the property will be hydroseeded to restore the vegetation. Hydroseeding is preferred over sod for its ease of initial maintenance and significant cost reduction. However, sod may be used in areas of properties with steep slopes that would be subject to erosion before the vegetation can be established. The estimated time for the cleanup of the 800 properties is approximately four years. Future land use is expected to continue to be residential.

The excavated soil will be disposed at an EPA approved disposal facility. The EPA has previously used the Timber Ridge Landfill in Richwoods, Missouri, in accordance with federal, state and local disposal permits. For contaminated soils which fail the Toxicity Characteristic Leaching Procedure (TCLP) analysis, a lead stabilization compound will be added to the soil at the residential property until the soil no longer fails the TCLP standard for lead. Additional disposal locations may be explored if they can meet applicable regulatory requirements.

Approximately 1,620 residences at the Site have not had their soil sampled by the EPA. Under this alternative, the EPA will continue to seek access to sample residential properties within the Big River floodplain, upon request from residences, and as evidence indicates areas that may be impacted by lead contaminated soils at the Site to determine if they have been impacted by mining-related activities. If a soil sample for a property quadrant has a lead concentration greater than 400 ppm, the property will be included in the RA.

The EPA will not intentionally address naturally occurring lead ores in their undisturbed state as part of this action. Although the Site has been heavily mined in the past, it may be possible to encounter naturally occurring lead ores during residential property excavation. Section 104(a)(3)(A) of CERCLA states that removal or RAs shall not be provided in response to a release or threat of release "of a naturally occurring substance in its unaltered form, or altered solely through natural processes or phenomena, from a location where it is naturally found." Naturally occurring lead ores could be found at the bedrock interface and in undisturbed clay soils near the ground surface. Another indicator of the presence of naturally occurring lead ores could be a high density of galena crystals in soils or unusually high concentrations of lead in excavated soils. When these conditions are encountered, they will be documented, excavation will stop and backfilling will be initiated.

The Agency for Toxic Substances and Disease Registry (ATSDR) recommends that home interiors regularly be cleaned of house dust and soil in areas where there is lead contamination for the purpose of reducing exposure to lead. This conclusion is also supported by the IEUBK Model, which includes a dust transfer factor that is based on the movement of outside soil lead into the interior of a home.

Due to the widespread lead contamination found at the Site, a health education program will be implemented to help reduce exposures that could potentially result in adverse health effects. An active educational program would be conducted in cooperation with the EPA, ATSDR, MDNR, Missouri Department of Health and Senior Services (MDHSS), and the Jefferson County Health Department. It is anticipated that EPA funding will be provided for the implementation of health

education activities during the implementation of the RAs. The following, although not an exhaustive list, indicates other types of education activities that may be conducted at the Site:

- Performing in-home assessments for children identified with elevated blood lead levels.
- Holding meetings with and acting as a resource for area physicians of local families.
- Providing community education through meetings, talks and presentations at civic clubs, schools, nurseries, preschools, churches, fairs, etc., and one-on-one family assistance.
- Undertaking special projects to increase awareness of how local citizens can protect themselves from lead exposure health risks.
- Vacuum loan out program for qualifying properties.

With regard to the visual barriers that have been and may be placed at depth at residential properties during the previous removal actions and this RA, the EPA will need to ensure that the visual barriers and the contaminated soils below them are not disturbed for long-term protection of human health. The EPA has historically looked to various types of ICs to ensure the remedy's long-term protectiveness. For this alternative, the EPA will work with state and local officials and land owners to explore potential ICs for properties where soil lead contamination remains at depth, e.g. where a visual barrier was placed; and on those properties where the EPA has data indicating surface soil lead contamination exceeds 400 ppm and the EPA was unable to obtain access from the property owner to perform soil remediation. All property owners where unacceptable levels of lead remain in place will be notified and provided information about the lead based paint lead disclosure requirements pursuant to the Toxic Substances Control Act (TSCA) Disclosure Rule that property owners would be required to follow.

Implementation of future governmental controls such as an ordinance requiring soil assessment sampling and permits for earthmoving activities, as well as restricting soil use in areas of known heavy-metal contamination, would be efficient and effective control measures. Discussion, collaboration and evaluation with the state of Missouri, Jefferson County and other local governments regarding these types of governmental controls will be initiated by the EPA.

The EPA will continue to evaluate other types of ICs for residential properties and mine wastes at the Site. Many of the ICs described will require participation from local and county governments. Other ICs being considered will include deed notices, local governmental controls such as building permit restrictions, restrictive covenants, builder and developer certifications that require specific training on best management practices when developing potential properties impacted by historical mining practices, and/or establishment of a registry of residential properties that have greater than 1,200 ppm at 12 inches bgs with the Jefferson County Health Department.

Alternative 3: Maximum Twenty-Four Inch Excavation, Disposal, Vegetative Cover, Health Education, and Institutional Controls

- Excavation and removal of surface soil above 400 ppm lead, with excavation continuing until either the underlying soil at the bottom of the excavation is less than 400 ppm lead, or to a maximum depth of 24 inches. A visual barrier will be placed at the base of 24-inch excavations where lead levels are at or exceed 1,200 ppm.

- Clean fill and topsoil replacement along with revegetation, the same as Alternative 2.

- Disposal of excavated soil at an EPA-approved disposal facility, the same as Alternative 2.

- Health education and outreach, the same as Alternative 2.

- Institutional Controls (ICs), the same as Alternative 2.

Just as in Alternative 2, under Alternative 3, residential properties with a quadrant showing a surface-soil sample result greater than 400 ppm for lead will be remediated. Also, the drip zone may be remediated if the lead concentrations in the drip zone are greater than 400 ppm and if another quadrant sample exceeds 400 ppm for lead. Residential properties where quadrant samples did not exceed 400 ppm lead would not be addressed under this action. Under this alternative, the 800 residential properties that contain or are expected to contain lead soil concentrations greater than 400 ppm will require remediation.

Approximately 1,620 residences at the Site have not had their soil sampled by the EPA. Under this alternative, the EPA will continue to seek access to and sample residential properties within the Big River floodplain, upon request from residences, and as evidence indicates areas that may be impacted by lead contaminated soils at the Site to determine if they have been impacted by mining-related activities, including the transportation and relocation of impacted soils.

The significant difference with this alternative when compared to Alternative 2 is that soil excavation would continue to a maximum depth of 24 inches where soil lead contamination is determined to be 400 ppm or greater. If at 24 inches bgs the soil lead concentration is equal to or greater than 1,200 ppm, the EPA would place a visual barrier prior to backfilling with clean soil and would implement ICs, as in Alternative 2, after consulting with ATSDR and MDHSS on the need for ICs for soil lead contamination remaining at the 24-inch depth. However, the EPA anticipates that the need for a visual barrier and ICs would be reduced (when compared to a 12-inch maximum depth excavation) because homeowners would rarely dig in their yards to depths exceeding 24 inches, and EPA believes that those occasions would not result in soil lead levels remaining at the surface that would pose a significant exposure risk to lead. The frequency of post remediation excavation by residents to depths greater than 24 inches is expected to be minimal over time, and the perpetual implementation of ICs would be necessary on fewer properties for human health and the environment to be protected.

Disposal, vegetation restoration and health education components of Alternative 3 are the same as Alternative 2. Future land use for the Site under Alternative 3 is expected to be similar to Alternative 2.

Common Elements and Distinguishing Features of Each Alternative

Alternative 1 is removed from consideration because it is not protective of human health and the environment and does not meet ARARs. The two remaining alternatives, Alternatives 2 and 3, include the common elements of the disposal, vegetation restoration, health education and ICs. Both alternatives are similar in their attainment of key ARARs. The cost of Alternative 3 is approximately 56 percent greater than Alternative 2, with Alternative 2 projected to cost approximately $28.4 million while Alternative 3 is projected to cost approximately $50.9 million. The key distinguishing feature of these two alternatives is the depth of soil excavation: 12 inches compared to 24 inches; otherwise, the alternatives are nearly identical.

It may take additional man-hours and resource time to complete Alternative 3 when compared to Alternative 2, due to the anticipated increase in soil excavated. The EPA estimates that there would be a 50 percent increase in soil excavated when implementing Alternative 3. Based on required funding and a RA contractor's approach, additional time may be needed to complete the remediation of the estimated 800 residential properties at the Site under alternative 3.

It is also likely that ICs such as visual barriers would be necessary at fewer properties under the implementation of Alternative 3 when compared to Alternative 2. However, it is not known how many properties this would affect. Furthermore, due to the uncertainty in whether individual residents would excavate soils in the future to depths greater than 24 inches, Alternative 3 may provide no greater degree of long-term effectiveness and permanence at residential properties where lead levels above levels of concern remain in place, and would not eliminate the need for similar ICs to those proposed in Alternative 2.

Expected Outcomes of the Alternatives

Excavation and replacement of contaminated surface soil as prescribed in Alternatives 2 and 3 would allow for unrestricted future use of many of the remediated properties. Under both alternatives, it is anticipated that a number of visual barriers will be required for placement at depth to indicate that lead-contaminated residential soil remains, although there may be a lesser number of barriers placed under alternative 3. Therefore, ICs will ultimately be needed for the Site. Residential use of all these properties could continue under either alternative.

As indicated above, Alternatives 2 and 3 are similar and while Alternative 3 may require a longer time to implement, the additional cost would allow more contractors to implement the remedy. Both Alternatives 2 and 3 have an estimated time frame of 4 years dependent on funding and contracting requirements. Both alternatives are implementable.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

According to the NCP, nine criteria are used to evaluate the different alternatives individually and against each other to select the best remedy. The nine evaluation criteria are: (1) overall

protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state/support agency acceptance; and (9) community acceptance. This section of the ROD profiles the relative performance of each alternative when measured against the nine criteria and each other. The nine evaluation criteria are discussed below. A detailed analysis of these alternatives can be found in the FS Report.

1. **Overall Protection of Human Health and the Environment:** Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced or controlled through treatment, engineering controls and/or ICs.

Alternative 1 does not provide protection for the environment or residents at the Site because no actions are taken to mitigate the exposure to lead-contaminated surface soil. Alternatives 2 and 3 would remove the significant exposure pathway associated with contaminated residential property soils. Once soil excavation, disposal, replacement and yard revegetation is complete, and enforceable ICs and an effective health education program are implemented, the risk of exposure through direct contact and subsequent ingestion of metal-contaminated residential property soil will be mitigated. Therefore, Alternatives 2 and 3 are protective of human health and the environment. Under Alternative 3, enforceable ICs may be necessary at fewer properties due to the minimal risk associated with post remediation excavations by homeowners to depths greater than 24 inches and fewer barriers may be required due to the greater excavation depth.

2. **Compliance with ARARs:** Section 121(d) of CERCLA and the NCP at § 300.430(f)(1)(ii)(B) require that RAs at Superfund sites meet or satisfy legally applicable or relevant and appropriate federal and state requirements, standards, criteria and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA § 121(d)(4). Therefore, this criterion evaluates whether the alternative meets federal and state ARARs that pertain to the Site or whether a waiver is justified. Applicable requirements are those cleanup standards, standards of control and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location or other circumstance found at a Superfund site. Relevant and appropriate requirements are those cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, RA, location or other circumstance at a Superfund site address problems or situations sufficiently similar to those encountered at the Superfund site that their use is well suited to the particular site. State standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable or relevant and appropriate.

The ARARs for this ROD are included in attached Tables 3 through 8. The no-action Alternative does not comply with ARARs. In contrast, Alternatives 2 and 3 would comply with chemical- and location-specific ARARs. Action-specific federal and state ARARs would be achieved by making sure all soil above the cleanup level is excavated, transported and disposed of properly.

Storm water runoff will be kept to a minimum during soil excavation, disposal, borrow replacement and hydroseeding using best management practices, thus keeping local streams free of additional sediment. Dust suppression will be used during all phases of construction, and time spent at each residence will be kept to a minimum to minimize potential exposure to the residents. All precautions will be considered at each location to ensure that excavation will not hinder or interfere with wildlife and local streams. Property owners with remaining lead contamination would be informed of their obligation to comply with disclosure requirements in accordance with the TSCA lead based paint Disclosure Rule.

Having failed to meet both previous criteria called the threshold criteria, Alternative 1, the No-Action Alternative, is eliminated and will not be included in further NCP criteria analysis.

3. <u>Long-term Effectiveness and Permanence</u>: Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Under Alternatives 2 and 3, the residual risks (the risk remaining after implementation) would be significantly reduced. Residential properties within the Site with soil concentrations at or above 400 ppm lead in Alternatives 2 and 3 would have contaminated surface soil removed to a depth that meets the cleanup level, up to a depth of 12 inches or 24 inches, respectively. The removal of contaminated soil, replacement with clean soil and revegetation ensures that future potential for exposure will be significantly reduced. Alternatives 2 and 3 provide permanence through removal and containment of contaminated soils at or above 400 ppm at the prescribed maximum depths of 12 inches or 24 inches, respectively.

A significant aspect of Alternatives 2 and 3 is the disposal of the contaminated soils at an EPA-approved disposal facility. A landfill would be required to meet all federal, state and local permit requirements prior to accepting the contaminated materials. If a repository were identified and selected, the repository would require storm water controls and other design and engineering controls for long-term effectiveness and stability. Maintenance of the repository would include routine inspections and repairs to erosion and vegetative cover. Storm-water monitoring would be required in accordance with existing permits. Excavated soils have been disposed of at the Timber Ridge landfill during the removal action. During the remedial design phase of the project, alternate disposal options will be explored.

Significant components of both Alternatives 2 and 3, which impact long-term protectiveness of excavated properties, are the health education and ICs. Because contamination will remain on-site after the implementation of the Selected Remedy, the implementation of these initiatives over the long term will be necessary to achieve the optimum reduction in risk of exposure to contamination remaining at depth in residential property soil.

Examples of ICs that would ensure long-term protectiveness of Alternatives 2 and 3 would include an ordinance restricting soil use in areas of known heavy-metal contamination or where barriers were placed at depth over soil contaminated with lead above 1,200 ppm, restrictive covenants or a requirement for building permits. The EPA will work with local citizens and

government officials at all levels to develop and implement effective ICs. Due to the uncertainty in whether individual residents would excavate soils in the future to depths greater than 24 inches, Alternative 3 may provide no greater degree of long-term effectiveness and permanence and may require similar ICs as those described in Alternative 2.

Reviews at least every five years would be necessary for Alternatives 2 and 3 to evaluate the effectiveness of these alternatives because lead soil concentrations above the health-based level of 400 ppm may remain at some residential properties.

4. <u>Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment</u>: Reduction of toxicity, mobility or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2 and 3 would significantly reduce the mobility of the COCs by consolidation of the contaminated soils at an EPA-approved disposal facility. These alternatives do not employ treatment as the mechanism to reduce toxicity, mobility or volume of contaminants, and, although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced by these alternatives with the exception of the treated and stabilized soils at the residential property which would otherwise fail TCLP. The toxicity of the stabilized soils would decrease, although the volume of soils requiring treatment due to failing TCLP analysis is not expected to be a significant portion of the excavated residential soils.

Proper long-term maintenance of the EPA-approved disposal facility is an important component of alternatives 2 and 3 to ensure the significant reduction of lead mobility. In the event that a landfill is used, such as the previously used Timber Ridge Landfill, the responsibility of long-term maintenance is the landfills. If a repository is identified and used, EPA will ensure proper long-term maintenance is conducted. The effective implementation of ICs for Alternatives 2 and 3 will likely contribute to the reduction of lead mobility because under a possible ordinance the community would receive notification concerning the need to characterize and/or certify that soil brought to or removed from their properties did not contain lead at concentrations exceeding 400 ppm. The mechanical movement by man of lead-contaminated soil is suspected to be a major contributor to the mobility of lead soil contamination at the Site, and effective ICs such as deed notices and local ordinances regulating soil movement will be explored to reduce lead mobility by mechanical movement.

5. <u>Short-term Effectiveness</u>: Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 2 and 3 have increased short-term risks for the public, environment, and construction workers from excavation and transportation efforts. Disturbed contaminated soil could enter the ambient air during excavation and transportation. However, dust suppression would be implemented for the protection of the community and workers during the RA. These alternatives would require several years to implement for all affected residences; however, the length of time at any one residence during excavation would be typically be minimal, and is estimated to be 2 to 3 days. Therefore, the potential exposure to contaminated dust by any

particular resident would be negligible. However, under Alternative 3, soil excavation at each residence could be up to twice as long, or approximately 6 days due to the potential depth of excavation being twice as deep as the excavation depth prescribed for Alternative 2. Alternative 2 may have greater short-term protectiveness due to a shorter implementation time frame and less excavation of soil. Additionally, Alternative 2 would have greater short-term effectiveness due to the likelihood that most residential properties requiring additional excavation at depths greater than 12 inches will be in the Big River floodplain. This creates more erosion issues during excavation for Alternative 3 as contrasted to Alternative 2, and with studies indicating increasing contamination with depth, ICs will still be required on most of these properties.

6. Implementability: Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility and coordination with other governmental entities are also considered.

Alternatives 2 and 3 are readily implementable because they are technically feasible from an engineering perspective. Excavation methods, backfilling and revegetation are typical and easy engineering controls. Excavation and replacement of contaminated surface soil is performed using conventional earth moving equipment and hand tools, and can be readily performed by trained operators and laborers. The experience of previous Site removal actions conducted by the EPA at this and other lead-mining Superfund sites has shown that the construction component of Alternatives 2 and 3 are readily implementable.

The health education and outreach components of Alternatives 2 and 3 are readily implementable and have been successfully implemented at other lead-mining sites in the region.

The ICs are also implementable components of Alternatives 2 and 3. Coordination between federal, state, county and local governments and interested citizens is required to discuss and evaluate proprietary controls such as deed notices, restrictive covenants and easements, and local governmental controls such as ordinances, building permit restrictions, and builder and developer certifications that require specific training on best management practices when developing properties potentially impacted by historical mining practices.

7. Cost: This criterion includes estimated capital costs as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The present worth cost for Alternative 2 is estimated to be $28.4 million. The present worth cost for Alternative 3 is estimated to be $55.5 million. For both cost estimates, capital costs are spread out over a construction period of four years. A five percent discount rate was used to calculate present worth. These estimates are approximate and made without detailed engineering data. The actual cost of the project would depend on the final scope of the RA, actual length of time required to implement the alternative and other unknown factors. Alternative 3 could require a longer timeframe than Alternative 2 or both remedies could be implemented in the same period of time if the rate of work is increased for Alternative 3. Equal time was assumed for cost estimating purposes.

The historical average amount of soil removed from each residential property during recent time-critical removal actions is 317 yd^3 at a contractor cost of $107 per yd^3. The future cost to remediate residential soil may vary somewhat from these past costs. Annual costs of $40,000 are estimated for public health education. No Operation and Maintenance (O&M) costs are incorporated in the total project cost estimates.

8. State/Support Agency Acceptance: This criterion considers whether the state agrees with the EPA's analyses and recommendations of the RI/FS, the Proposed Plan, and the ROD.

In a letter dated July 17, 2012, MDNR indicated concurrence with the Proposed Plan for the Southwest Jefferson County Mining site, OU-1, and supports the recommended alternative. It is anticipated that MDNR will further concur with the ROD.

9. Community Acceptance: This criterion considers whether the local community agrees with the EPA's analyses and preferred alternative from the Proposed Plan. Comments received on the Proposed Plan are important indicators of community acceptance.

In general, the local community, including local citizens and officials, support the Selected Remedy (generally presented in the Proposed Plan as the preferred alternative). A Responsiveness Summary, which captures public comments has been included as part of this ROD.

PRINCIPLE THREAT WASTES

According to the Office of Solid Waste and Emergency Response's (OSWER) Directive 9380.3-06FS (A Guide to Principal Threat and Low Level Threat Wastes) dated November 1991, "Principle threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur." Based on this definition, contaminated residential soil does not appear to be a principal threat waste because it is not a source material. The historic mine waste and materials deposited in the Big River constitute a principal threat to human health and the environment. In addition to the activities in this ROD, ongoing studies are being conducted as part of the remedial activities for OU-4. Additionally, the remaining lead-contaminated residential surface soils are neither highly toxic nor highly mobile in part because of previous removal actions. This ROD allows the EPA to address the highest priority at the Site—human health risk posed by residential property surface soil—while additional evaluations are performed at other OUs of the Site.

SELECTED REMEDY

Summary of the Rationale for the Selected Remedy

The Selected Remedy is Alternative 2: Maximum 12-Inch Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls. The Selected Remedy was chosen over the other alternatives by the EPA because, among other reasons, it will achieve the RAOs and provide the best balance of trade-offs with respect to the nine NCP criteria. Alternative 2 is a continuation of the previous removal actions to excavate and replace lead-contaminated

residential surface soil at the Site. Of the two active alternatives which meet the threshold criteria, Alternative 2 is the better of the two alternatives with respect to short-term effectiveness because there will be less potential for exposure to dust generated during soil disturbance activities as compared to Alternative 3. Alternative 2 is also better with respect to cost, as it is estimated to be approximately $27 million less than Alternative 3. Additionally, at other lead-mining Superfund sites, the EPA has met the RAO for lead in soil by employing alternatives similar to Alternative 2 with respect to the key components. Health education and outreach will further reduce the exposure to potential exterior lead sources and interior lead dust. Finally, the EPA will help develop workable and successful ICs with input from the community and government stakeholders. ICs being considered include deed notices, local governmental controls such as building permit restrictions, restrictive covenants, builder and developer certifications that require specific training on best management practices when developing properties impacted by historical mining practices, and a registry of sampled and remediated homes by the Jefferson County Health Department. Ultimately, ICs are needed by the EPA to ensure that any visual barriers placed at depth are not disturbed for long-term protection of human health.

The HHRA, which is the basis for the RAOs, clearly supports the need to take action at residential properties as soon as possible. It is important not to delay the RA to address other issues such as implementing health education and ICs. Due to the large number of residential properties requiring remediation, it is estimated to require four years to implement the Selected Remedy.

Description of the Selected Remedy

Alternative 2: Maximum 12-Inch Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls
Estimated Total Capital Cost: $31.8 million
Estimated Annual O&M Cost Range: $0
Estimated Present Worth Cost: $28.4 million
Estimated Construction Time Frame: 4 years
Estimated Time to Achieve RAOs: 4 years

Under this alternative, residential properties with at least one quadrant sample testing greater than or equal to 400 ppm for lead will have that quadrant remediated. The drip zones may be remediated if the lead concentrations in the drip zones are greater than or equal to 400 ppm and at least one quadrant is greater than or equal to 400 ppm. Residential properties where no quadrant samples exceed 400 ppm lead would not be addressed. An estimated 800 residential properties contain soil lead concentrations greater than or equal to 400 ppm and will require remediation. This is based on the number of properties that have been tested in combination with projected estimates in properties to test in the future.

Approximately 1,620 residential properties at the Site have not had their surface soil sampled by the EPA. Under this alternative, EPA will identify residential properties within the Big River's 100-year floodplain, on historic mining sites, and where contaminants are known to have been transported and attempt to sample them for lead contamination. If a surface soil sample in a property's quadrant has a lead concentration greater than 400 ppm, the property will be included in the RA.

Excavation: This alternative includes the excavation and removal of lead-contaminated surface soil, backfilling the excavation with clean soil and seeding. Excavation of a residential property would be triggered when the highest recorded surface soil sample for any defined area of the property contains greater than 400 ppm lead. Soil would be excavated using limited-size and lightweight excavation equipment and hand tools in the portions of the property where the surface soil exceeds 400 ppm lead. Excavation will continue in depth until the underlying soil at the bottom of the excavation is less than 400 ppm lead or to a maximum depth of 12 inches bgs. An exception is garden areas, where the maximum depth of excavation will be 24 inches bgs.

If at 12 inches bgs the lead soil concentration is greater than 1,200 ppm, the EPA will place a visible barrier at 12 inches bgs. The barrier placed will be a visible plastic barrier (such as an orange-mesh plastic sheet) that is permeable, wide meshed and will not affect soil hydrology or vegetation. The barrier will function as a visual warning that digging lower will result in exposure to soil contaminated at a level that the EPA has determined to be a human health concern. The EPA recommends a minimum of 12 inches of clean soil be used as an adequate soil barrier from soil contaminated above the cleanup level for the protection of human health. The rationale for establishing a minimum clean soil thickness of 12 inches is that the top 12 inches of soil is considered available for direct human contact. Clean fill and topsoil would be used to replace soil removed after excavation, returning the residential property to its original elevation and grade. Clean fill and topsoil means, at a minimum, containing a lead level less than 100 ppm, an arsenic level less than 19 ppm, a cadmium level less than 16 ppm and a barium level less than 7,500 ppm.

As indicated earlier, the EPA estimates that 800 residences have been or will be discovered to have lead concentrations in surface soil greater than 400 ppm. Based on the EPA's previous soil removal activities at the Site, an average residential property will require removal and replacement of 317 yd^3 of soil and the EPA anticipates an average increase in yard excavation to 330 yd^3 due to potential increased contamination in the Big River floodplain. Therefore, an estimated total of approximately 264,000 yd^3 of soil would require excavation, disposal and replacement. This estimated total is used as the basis for part of the cost estimate for this RA.

Disposal: The excavated soil will be disposed of at Timber Ridge Landfill, or another EPA-approved disposal facility. The EPA has previously used the Timber Ridge Landfill for disposal of excavated, lead-contaminated soil. For contaminated soil which fails the TCLP analysis, a lead-stabilization compound will be added to the soil at the residential property until the soil meets the TCLP maximum concentration for lead. Regulatory requirements for disposal of the soil will be followed.

Revegetation: After the topsoil has been replaced, properties would be hydroseeded to restore the vegetation. Hydroseeding is preferred over sodding for its ease of initial maintenance and significant cost reduction. However, sod may be used in areas of properties with steep slopes that would be subject to erosion before the vegetation could become established.

Health Education: Due to the environmental problems of lead and other metals at the Site, health education will be needed during the response actions to help reduce exposures that could potentially lead to adverse health effects. An active educational program would be conducted in

cooperation with the EPA, ATSDR, MDNR, MDHSS, and the Jefferson County Health Department. The following, although not an exhaustive list, indicates the types of education activities that may be conducted at the Site:

- Performing in-home assessments for children identified with elevated blood lead levels.
- Holding meetings with and acting as a resource for area physicians of local families.
- Providing community education through meetings, talks and presentations at civic clubs, schools, nurseries, preschools, churches, fairs, etc., and one-on-one family assistance.
- Undertaking special projects to increase awareness of how local citizens can protect themselves from lead exposure health risks.
- Distribution of HEPA vacuums to residences and providing household cleaning and exposure-reduction instruction though a county-maintained, loan-out program.

Institutional Controls: With regard to the visual barriers that have been and may be placed at depth in residential properties during the previous removal actions and the upcoming RA, respectively, the EPA will need to ensure that the barriers and the soil below them are not disturbed for long-term protection of human health. Typically, the EPA has looked to various types of ICs to ensure the remedy's long-term protectiveness. While the EPA has considered proprietary controls such as restrictive covenants at similar sites, these controls present a great difficulty at this Site given the large number of residential properties that may be covered by the remedy. However, the EPA will continue to evaluate the feasibility of these controls as the RA selected in this ROD is being implemented.

Governmental controls such as an ordinance requiring permits for earth-moving activities and restricting soil use in areas of known heavy-metal contamination at depth would be an efficient and effective control measure. Collaboration and evaluation with the state of Missouri, Jefferson County Health Department and other local governments regarding ICs will need to be initiated. The EPA will work with state and local governments to develop and implement ICs. Some of these controls would address protection of any visual barriers laid down at depth at residential properties during the upcoming RA. The EPA will also continue to evaluate other types of ICs for residential properties and mine wastes at the Site. Many of the ICs described will require participation from local and county governments. Other ICs being considered will include deed notices, local governmental controls such as building permit restrictions, restrictive covenants, builder and developer certifications that require specific training on best management practices when developing potential properties impacted by historical mining practices, and/or establishment of a registry of residential properties that have greater than 1,200 ppm at 12 inches bgs with the Jefferson County Health Department.

Summary of the Estimated Remedy Costs

The present worth cost for the Selected Remedy is estimated to be $28.4 million and is presented in Table 9. The capital costs are spread over a construction period of four years once the contract for the RA is initiated. A present worth analysis was performed to evaluate project costs over

four years and is included in Table 9. This estimate is approximate and made without detailed engineering data. The information in Table 9 is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the implementation of the RA. Major changes, if they arise, may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or an amendment to this ROD. This is an order-of-magnitude engineering cost estimate that is expected to be accurate within +50 to -30 percent of the actual project cost.

Expected Outcomes of the Selected Remedy

The Selected Remedy will provide an accelerated response to residential property surface soil contaminated with lead above the cleanup level and will significantly improve human health protection in the community. The cleanup level of 400 ppm lead in surface soil is based on the HHRA and RAOs. The Selected Remedy will take an estimated four years to implement due to the large number of properties involved. The strategy allows for further assessment of the other OUs at the Site, while exposure to lead in surface soil at residential properties, which poses the highest human health risk, is remediated through the well-demonstrated approach of excavation and soil replacement.

Regarding future land use of the remediated residential properties, continued residential use is anticipated. With adequate IC development, the land use will actually be enhanced because lead-contaminated surface soil that would pose a human-health risk will be excavated from the large majority of residential properties. For residential properties where a visual barrier will be placed at depth and a potential IC put in place to protect the barrier, the upper 12 inches of soil at least would be available for direct human contact under the Selected Remedy.

STATUTORY DETERMINATIONS

The EPA expects the Selected Remedy to satisfy the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment at remediated residential properties by achieving the RAOs through a well-demonstrated approach using conventional engineering measures. Risks associated with lead-contaminated residential soil at the Site are caused by the potential for direct contact with contaminated surface soil. The Selected Remedy eliminates this direct exposure pathway through excavation and replacement of lead-contaminated surface soil at the residential properties. Contaminated surface soil will be removed from residential properties up to a depth of 12 inches bgs, except in existing vegetable gardens where it will be removed up to 24 inches bgs. The implementation of the Selected Remedy will not pose unacceptable short-term risks or cross-media impacts.

Compliance with ARARs

The Selected Remedy is expected to meet all chemical-specific, action-specific, and location-specific ARARs and does not involve any waivers. Because there are many ARARs, the ARARs for this ROD are included in Tables 3 through 8.

The excavated soil will be disposed of at Timber Ridge Landfill, or another EPA-approved disposal facility. The EPA has previously used the Timber Ridge Landfill for disposal of excavated, lead-contaminated soil. For contaminated soil which fails the TCLP analysis, a lead-stabilization compound will be added to the soil at the residential property until the soil meets the TCLP maximum concentration for lead. Regulatory requirements for disposal of the soil will be followed.

Cost Effectiveness

The Selected Remedy is a cost-effective solution to lead-contaminated residential surface soil at the Site. The cost difference between the Selected Remedy at approximately $28.4 million and the other alternative that meets the threshold criteria (Alternative 3) at approximately $55.5 million is $27.1 million or 51 percent. The excavation and replacement of contaminated surface soil in the Selected Remedy has the highest level of short-term effectiveness of the alternatives evaluated. No treatment technologies were identified that could demonstrate short- or long-term effectiveness and permanence for remediation of residential surface soil at this time. Although not achieved through treatment, the Selected Remedy does result in reduced mobility of Site contaminants through engineering controls. The Selected Remedy relies on conventional engineering methods that are easily implemented. Contaminated surface soil is removed and replaced, thereby providing a permanent remedy for remediated residential surface soil which will not be subject to future costs.

Utilization of Permanent Solutions and Alternate Treatment Technologies to the Maximum Extent Practicable

The Selected Remedy uses a well-demonstrated remediation approach to lead-contaminated surface soil that will provide a permanent remedy for residential soil by removing heavy-metal contaminants as a potential source of exposure to residents and children in particular. For a subset of excavated, contaminated residential soils, lead stabilization treatment is needed to prevent the soil from failing TCLP. However, the volume of this soil is not expected to be a significant portion of the excavated residential soil. No additional treatment technologies were identified that could be considered reliable at this time. Treatment for disposal is estimated to be minimal. The ICs and health education will add to the long-term effectiveness for this Site.

Preference for Treatment

The Selected Remedy does not use treatment to address the risks posed by the residential property surface soil. No treatment technologies were identified that have definitively demonstrated the ability to reliably provide short- and long-term effectiveness, permanence and meet the other NCP criteria. The agency considered phosphate treatment for reducing the risk of exposure to lead in soils during the screening phase of development of the FS and eliminated this

technology from further consideration as a remedial alternative. At that time, extended study of the phosphate treatment of soils at the Oronogo-Duenweg Superfund site in Jasper County, Missouri, had achieved a maximum of 40 percent reduction in bioavailability over a seven-year study period. However, the technology had not undergone any implementability testing at a residential property by the EPA. A recent review of the technology at the Omaha Lead site entitled, "Evaluation of Phosphate Treatment at Residential Properties; Omaha Lead Site, Omaha, Nebraska" had indicated concern about implementability, cost effectiveness and community acceptance in a residential setting as well as the long-term presence and monitoring of lead in the soil even if its bioavailability has been reduced. Based on these studies and the similarity in sites, the EPA concluded that phosphate treatment of residential soils contaminated with lead would no longer be considered for evaluation as a remedial alternative for OU-1. For a subset of excavated, contaminated residential soils, lead stabilization treatment is needed to prevent the soil from failing TCLP. However, the volume of this soil is not expected to be a significant portion of the excavated residential soil.

Based upon the information currently available, the EPA believes the Selected Remedy meets the threshold criteria and provides the best balance of trade-offs among the other alternatives with respect to the balancing and modifying criteria. The EPA concludes that the Selected Remedy satisfies the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met.

Five-Year Review Requirements

At remediated residential properties where no visual barriers are placed at depth, the Selected Remedy does not result in hazardous substances, pollutants or contaminants remaining on-site and thus allows for unlimited use and unrestricted exposure. However, at properties where barriers are placed at depth, lead is left on-site at levels that do not allow unlimited use and unrestricted exposure. Additionally, the consolidation of the lead-contaminated residential soil at Timber Ridge Landfill does not require a five-year review; however, other potential repositories may result in contamination left in place that may require five-year reviews. Therefore, the Selected Remedy is subject to periodic five-year reviews in accordance with section 121(c) of CERCLA and the NCP at 40 CFR § 300.430(f)(5)(iii)(C).

DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes from the Proposed Plan have been introduced in this Record of Decision.

Responsiveness Summary
Residential Property Surface Soil (OU-1)
Southwest Jefferson County Mining Site
Jefferson County, Missouri

This Responsiveness Summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP), 40 CFR § 300.430(f). This document provides the U.S. Environmental Protection Agency's response to all significant comments received from the public on the Proposed Plan for the residential properties portion of the Southwest Jefferson County Mining site (Site) during the comment period.

The Responsiveness Summary consists of the following three components: an overview of the public process, stakeholder issues and the EPA responses, and technical and legal issues and the EPA responses. This document is provided to accompany the Record of Decision (ROD) and reflects input resulting from the public comment process.

Overview

The Proposed Plan and supporting documents included in the Administrative Record (AR) file were made available for public review and comment from July 5, 2012, to August 12, 2012. A public meeting was held at the Jefferson County Fairgrounds in Hillsboro, Missouri, on July 17, 2012, with eight local officials and citizens in attendance. Questions and comments were received at the July 17, 2012 public meeting following the EPA's formal presentation. In addition to comments received during the public meeting, the EPA received written public comments inclusive of electronically submitted e-mail, concerning the proposed plan. Copies, and/or summaries of written comments and a transcript from the public meeting are included in the AR. This Responsiveness Summary contains a summary of significant public comments and the EPA responses.

Stakeholder Issues and the EPA Responses:

Comments received by Mail

Comment:

> *Commenter believes that cleanup levels have changed throughout the course of the removal action, and that the proposed cleanup goal of 400 ppm lead in soil is an example of government waste. Commenter feels that alternative 1 is the best choice. Commenter also wants EPA to consider drought conditions in the event that EPA selects any actions.*

Response:

> The EPA has maintained a time critical removal action level of 1,200 ppm for residential yards and 400 ppm for daycare facilities to reduce the highest risk at the Site. Schools were evaluated by the EPA risk assessors and actions were

conducted based on their recommendations. The EPA conducted a RI/FS to determine the risk remaining at the Site and developed an appropriate cleanup concentration for the remedial action, which was determined to be 400 ppm. This action will reduce the risk of exposure of young children (children 0 to 84 months) to lead such that an individual child or group of similarly exposed children have no greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dl. It will also reduce the collocated risk of exposure to soils containing arsenic and chromium such that levels do not exceed the carcinogenic risk of 1 x 10^{-4} and a noncancer hazard index of 1. The EPA disagrees that Alternative 1 is the best choice. The EPA does not believe that Alternative 1 will provide adequate protection to human health.

The EPA will take drought and other site conditions into account during the course of the project.

Comments Received Via Email

Comment:

Commenter agrees with the proposed remedy, and believes that the same cleanup strategy employed for the time critical removal actions should be implemented at the remaining non time critical contaminated properties.

Commenter also inquired about the time frame that construction activity might begin.

Response:

The EPA agrees with the commenter on the proposed remedy. The EPA does not currently have a time frame for beginning construction activities, but will complete a Remedial Design and have the site ranked for project funding. When the Remedial Design is completed and funding becomes available for construction, the EPA will begin to implement the remedy.

Comment:

Homeowner inquired if, because of the information in the fact sheet and newly proposed remedy, she should have her well retested, even though it was tested by EPA four years ago. Commenter also noted that she installed a water softener since the previous testing.

Response:

The EPA is not recommending additional testing to properties already tested.

Comments from the public meeting

Comment:

Commenter would like to know about surface water at lake communities and if EPA plans to sample those areas.

Response:

The EPA will evaluate properties in lake communities by obtaining access from property owners. Surface waters, such as lakes will be sampled if ownership extends into the lake. Risk from surface water exposure will be evaluated in the OU-4 Human Health Risk Assessment.

Comment:

What if the clean-up value changes over a period of time, for example if the value is reduced in 10 years?

Response:

The EPA's health protection goal is that there should be no more than a 5 percent chance of exceeding a blood lead level of 10 µg/dl in a given child or group of similarly exposed children. The Centers for Disease Control and Prevention has recently eliminated the 10 µg/dl level of concern for lead in children's blood and proposed a reference value which is tied to the highest 2.5 percent of child blood lead levels tested. The reference value is currently set at a blood lead level of 5 µg/dl and could vary over time. The EPA is considering this change and how to incorporate it in the IEUBK modeling process and its application to determining PRGs and cleanup levels. In the interim, the EPA will continue to use the IEUBK model as described in the risk assessment in determining PRGs.

Comment:

Commenter wants to know about mobility of lead soils from one property to another through erosion.

Response:

Erosion in a residential setting is typically not an issue, and vegetation in yards is generally sufficient to prevent runoff; however, all properties must be evaluated individually for that risk as properties throughout the Site vary widely.

Comment:

John Smith from the Jefferson County Health Department reemphasized that blood lead testing is available at the Jefferson County Health Department by appointment.

Comment:

Commenter has a farm, with the lower part of the farm in the lower floodplain. Commenter wants to know if EPA will be doing anything about the tailings upstream that are causing the impacts to the Big River.

Response:

The EPA is taking several actions to address upstream mine tailings. Many of those actions are at other upstream mining sites including the Big River Mine Tailings site. The EPA is currently performing an Ecological Risk Assessment as part of OU-4, which includes the unconsolidated Mine Waste in Jefferson County including the Big River, the Big River floodplain, rail lines and historic mine areas. The EPA will also be conducting a Human Health Risk Assessment to assist in completing the Remedial Investigation/Feasibility Study. These studies will result in a Proposed Plan which will present preferred remedy option to the public.

The EPA is also conducting response actions at various mine tailings piles as part of the Big River Mine Tailings Site.

Comment:

Commenter is concerned about the potential that children are being exposed to sand and gravel bars along the river.

Response:

Gravel bars will be part of the Site decision for OU-4. The EPA will sample those gravel bars near residential properties if there is evidence that the area is used as a play area and it can be safely reached. Results will be sent to nearby homeowners and/or be available with the Jefferson County Health Department and the EPA.

Comment:

Multiple commenters would like to have their properties sampled.

Response:

The EPA will sample properties upon request. Requestors can verbally request sampling and the EPA will collect the information, or requestors can call or email the EPA and they will be added to the sampling list. The EPA is also conducting residential sampling along the Big River floodplain and in the southwest quadrant of the county. As part of that effort EPA is sending out mailings with access agreements for sampling to home owners.

Comment:

Commenter would like to know about sampling outside of the 1-acre area since children on his property often play in areas outside of those boundaries.

Response:

The EPA will sample play areas outside of the 1-acre boundary if the owner identifies the area.

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APPENDIX A

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GLOSSARY OF TERMS

This glossary defines many of the technical terms used in relation to the Southwest Jefferson County Mining Site in this ROD. The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management and apply specifically to work performed under the Superfund program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record (AR): All documents which EPA considers or relies upon in selecting the response action at a Superfund site, culminating in the Record of Decision for remedial action.

Baseline Human Health Risk Assessment (HHRA): A document that provides an evaluation of the potential threat to human health in the absence of any remedial action.

Bioavailability: A risk assessment term: the fraction of an ingested dose that crosses the gastrointestinal epithelium in the stomach and becomes available for distribution to internal target tissues and organs.

Blood lead level or concentration: The concentration of lead in the blood, measured in micrograms of lead per deciliter of blood (µg/dL).

Capital Cost: Direct (construction) and indirect (nonconstruction and overhead) costs including expenditures for equipment, labor, and materials necessary to implement remedial actions.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The acts created a special tax that went into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either; (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back the federal government the cost of the cleanup.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that can have an adverse effect on human health or environmental receptors.

Contaminant of Concern (COC): A substance detected at a hazardous waste site that has the potential to affect receptors adversely due to its concentration, distribution, and mode of toxicity.

Discount rate: A percentage rate used in present worth analyses to identify the cost of capital and operation and maintenance expenses. It is used to value a project using the concepts of the time-value of money where future cash flows are estimated and discounted to give them a present value.

Dolomite: A sedimentary rock containing greater than 50% of the mineral dolomite; often found with calcite in forming limestone, another sedimentary rock.

Exposure pathways: The course a chemical or physical agent takes from a source to an exposed organism. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route.

Feasibility Study (FS): A report that analyzes the practicability of potential remedial actions; i.e., a description and analysis of potential cleanup alternatives for a site on the National Priorities List.

Groundwater: Water filling spaces between soil, sand, rock and gravel particles beneath the earth's surface, which often serves as a source of drinking water.

National Contingency Plan (NCP): The federal regulation that guides the Superfund program.

National Priorities List: EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System.

Operation and Maintenance (O&M): Activities conducted at a site after response actions occur to ensure that the cleanup or containment system continues to be effective.

Present worth: The amount of money necessary to secure the promise of future payment or series of payments at an assumed interest rate.

Proposed Plan: A plan for a site cleanup that is available to the public for comment which summarizes remedy alternatives and presents EPA's Preferred Alternative or cleanup approach.

Quadrant sample: A composite surface soil sample collected from a portion (usually one quarter) of a residential property.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at a National Priorities List site.

Remedial action: The actual construction or implementation phase of a Superfund site cleanup.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action, and support technical and cost analyses of alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Removal action: Short-term immediate actions taken to address releases of hazardous substances that require an expedited response.

Responsiveness Summary: A summary of oral and/or written public comments received by EPA during a comment period on key EPA documents and EPA's response to those comments.

Toxicity: The degree to which a chemical substance (or physical agent) elicits a deleterious or adverse effect upon the biological system of an organism exposed to the substance over a designated time period.

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APPENDIX B

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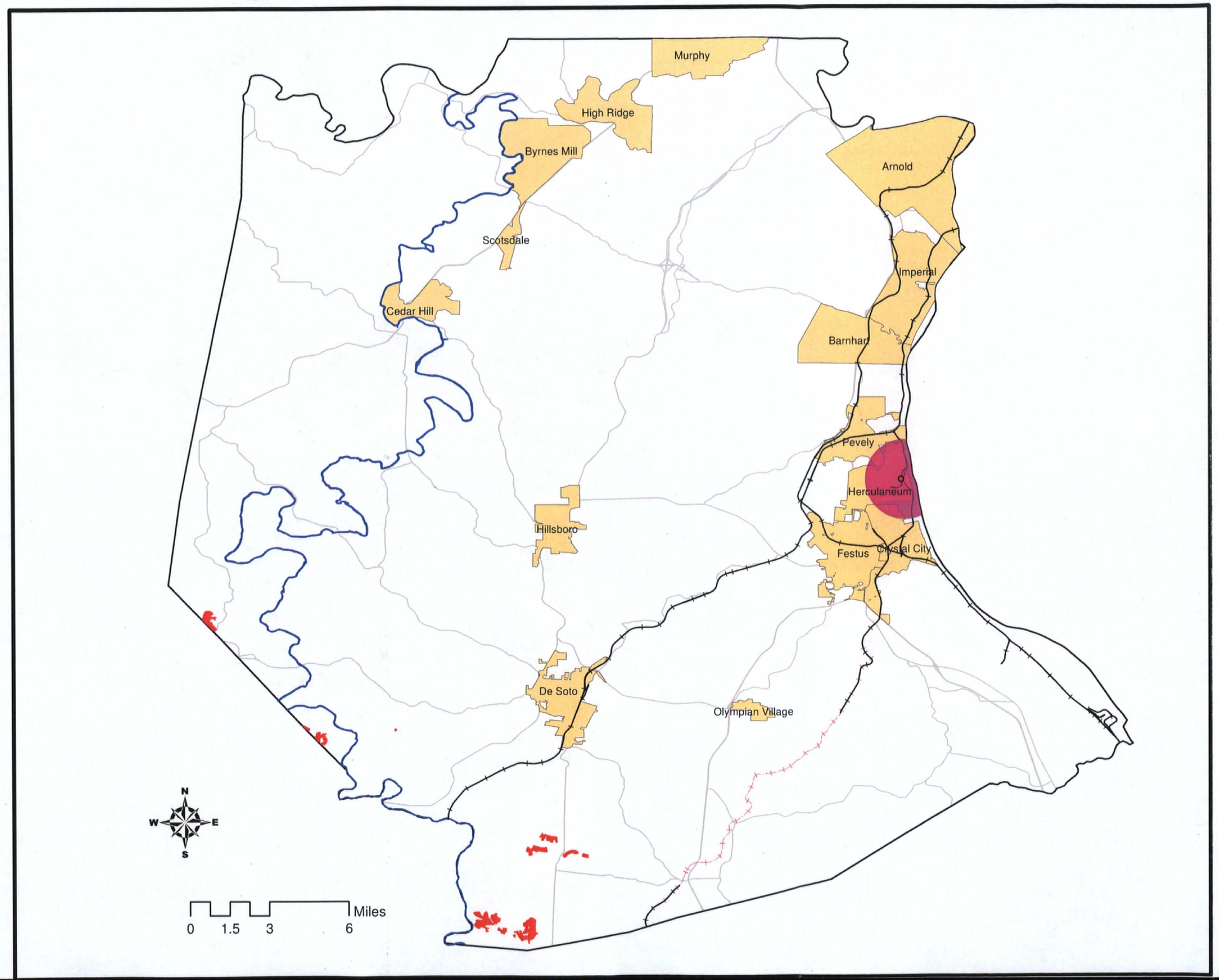
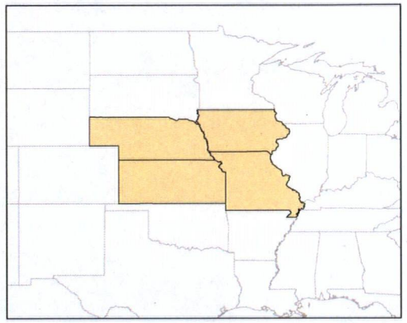
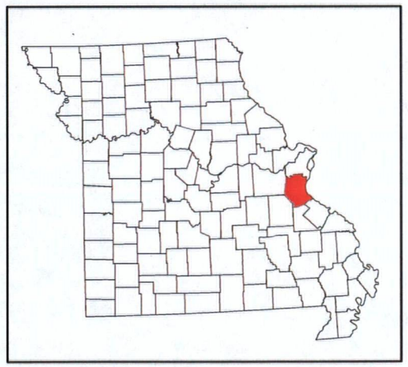
Figure 1. Southwest Jefferson County Mining Site

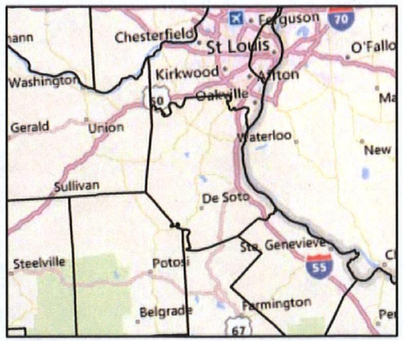


Legend

- Jefferson County
- Cities
- Highways
- Big River
- Railroads
- Abandoned railline approx. from aerial photo
- Mined Lands
- Herculaneum Shot Tower
- Herculaneum Site (Excluded)







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Date:04/23/12
FIleName:
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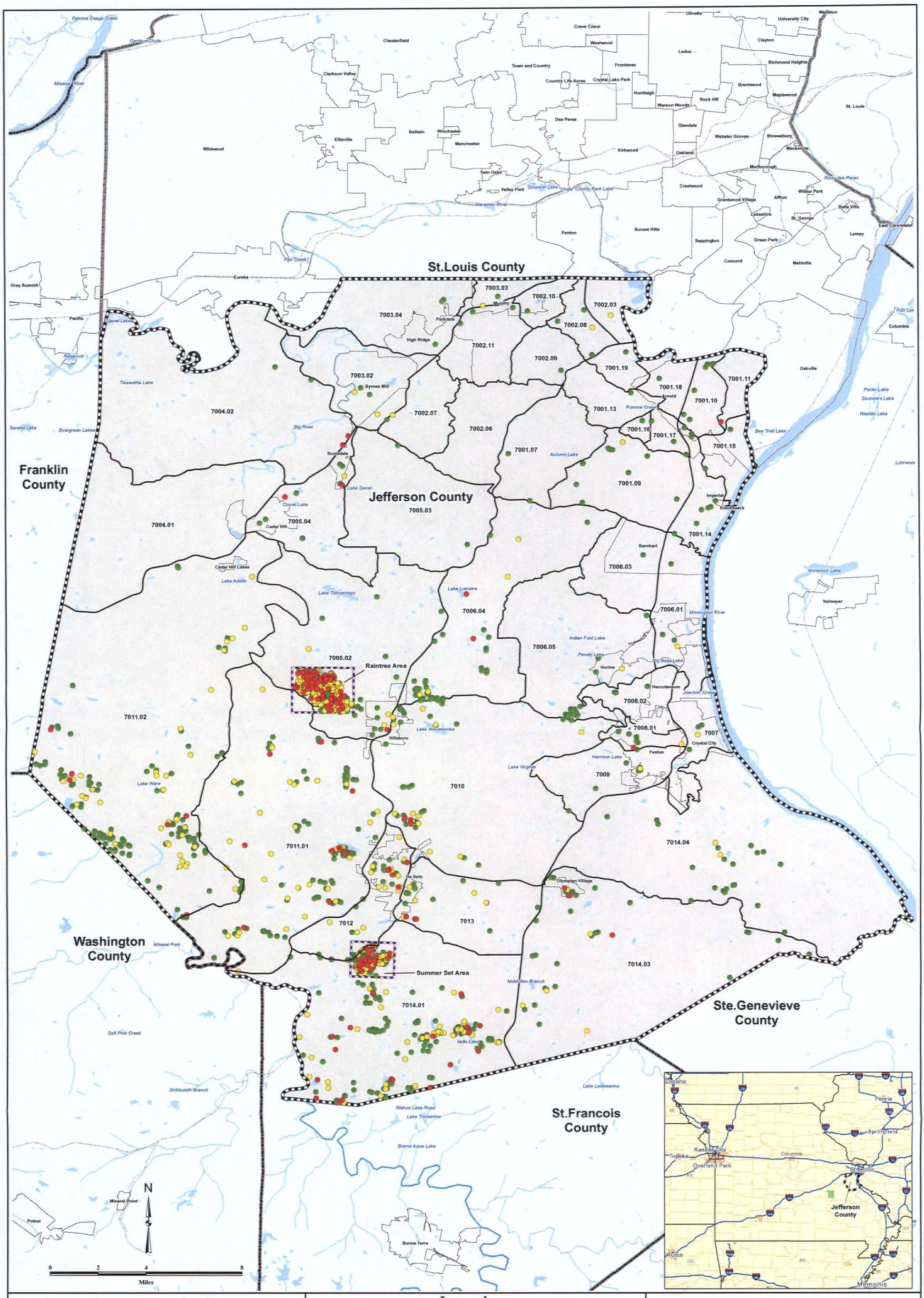

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Project: EP9042.01.55.01.00.00
Revised: 04/25/12 ST

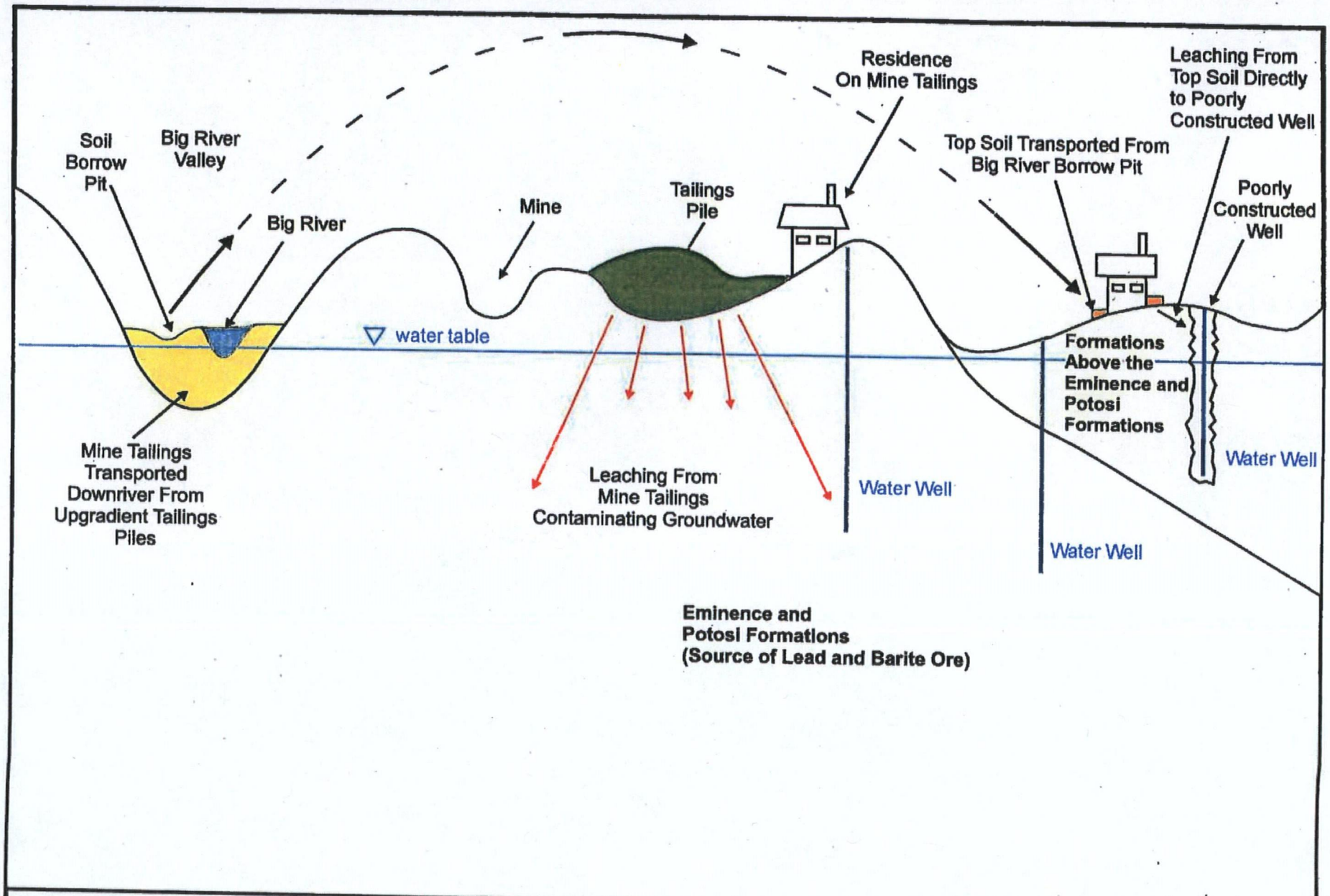
HGL HydroGeoLogic, Inc

Legend

- 1040 Properties with Lead Screening Result < 399 ppm
- 409 Properties with Lead Screening Result ≥400 & ≤ 1199 ppm
- 162 Properties with Lead Screening Result > 1200 ppm
- Raintree and Summerset Zones
- 7001.09 — 2010 Census Tract

Source: SW Jefferson Co. Mining Sites Database, April 2012

Figure 2
Jefferson County Census Tracts and OU1 Lead XRF Screening Results
Southwest Jefferson County Mining Site
Jefferson County, Missouri



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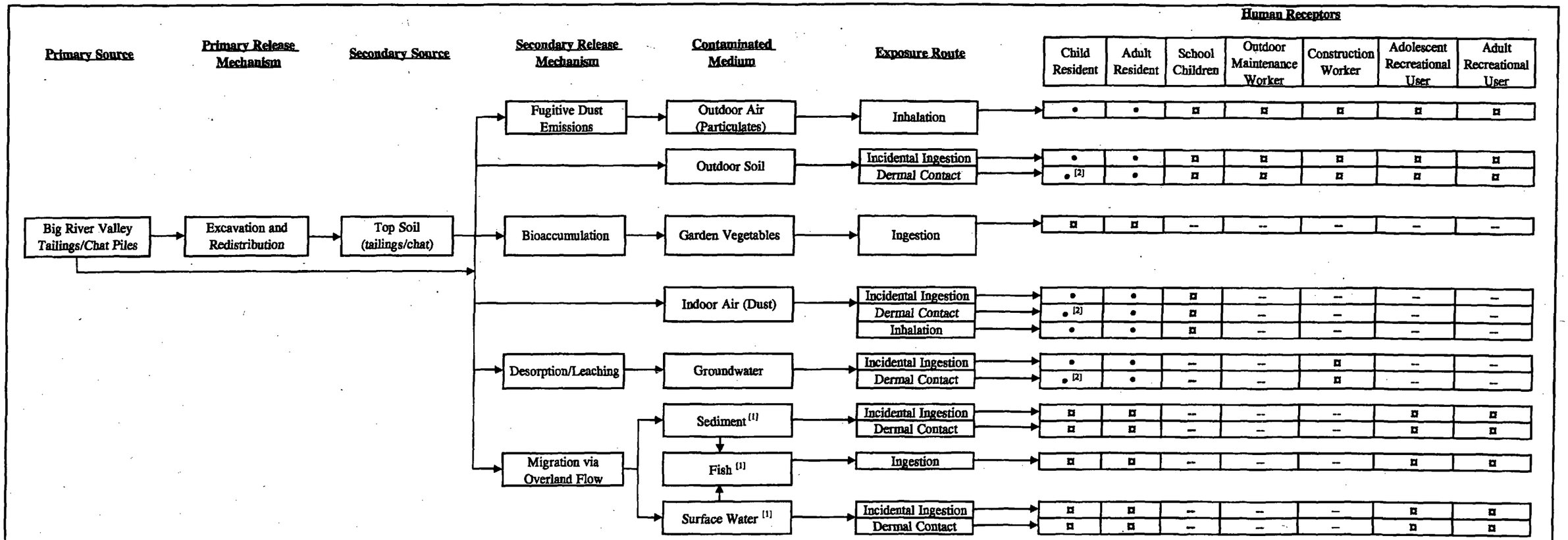
Project: EP9042.01.55.01.00
Revised: 11/09/11 ST
Source: HGL

HGL

Figure 3
General Site Conceptual Model
For Fate and Transport of Heavy Metals
From Mine Spoils for Groundwater and Soil

Figure 4
Site Conceptual Exposure Model, Human Health Risk Assessment
Southwest Jefferson County Mining Site
Jefferson County, Missouri



•	The exposure pathway is potentially complete and is quantitatively evaluated.
¤	The exposure pathway is potentially complete, but is not quantitatively evaluated.
--	The exposure pathway is incomplete.

Notes:
All child lead risk computed using IEUBK Lead Model (EPA, 1994). The IUEBK lead model does not compute dermal exposure.
Child and adult TAL metal risk computed with conventional RAGS techniques.
Risks associated with non-resident receptors are bounded by the child and adult resident receptors and are not quantified.
[1] Exposure to these media are not quantified because they are part of Operable Unit 4. Risks from exposure to these media will be assessed in a separate document.
[2] The dermal contact exposure route is quantitatively evaluated for all TAL metals except lead, as the IEUBK lead model does not compute dermal exposure.

APPENDIX C

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Table 1. Preliminary Cleanup Levels for COCs

COCs	Cleanup Level [1]
	ppm
Arsenic	22
Chromium	29
Lead	400

COC = contaminant of concern
ppm = parts per million
[1] Cleanup levels are based on EPA Regional Screening Levels (RSLs) at a carcinogenic risk of 1x10-4 or a noncancer hazard index of 1. The lead cleanup level results in a blood lead level of less than 10 µg/dL based on the IEUBK model.

TABLE 2

CURRENT RISKS TO CHILDREN FROM INGESTION OF LEAD IN SURFACE SOIL

IEUBK Modeling Results, Maximum Predicted Blood Lead Levels by Property

Southwest Jefferson County Mining Site

Jefferson County, Missouri

IEUBK Modeling Results Summary			
	Number of Properties	Total Properties	Percentage
P(BLL>10) <5%	1408	1951	72%
P(BLL >10) >5%	543	1951	28%
Property Range above P(BLL >10) >5%			
5% <P10 < 10%	87	543	16%
10% <P10 <20%	108	543	20%
20% <P10 <50%	163	543	30%
50% <P10	185	543	34%

Table 3
Federal Chemical-Specific ARARs

	Citations	Description
A. ARARs		
1. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life. May be relevant and appropriate to surface water discharges.
2. Clean Air Act	National Primary and Secondary Ambient Air Quality Standards 40 C.F.R. Part 50	Establishes standards for ambient air quality to protect public health and welfare.
3. Residential Lead-Based Paint Hazard Reduction Act	Toxic Substances Control Act (TSCA) Disclosure Rule 1018, August 2009, 40 C.F.R. Part 745.220 Subpart L	Requires persons conducting lead-based paint activities, which includes cleanup of lead-contaminated soil, to follow certification requirements and work practice standards.
B. To Be Considered		
1. EPA Revised Interim Soil-lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities and 1998 Clarification	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, July 14, 1994, OSWER Directive 9200.4-27P, August 1988	Establishes screening levels for lead in soil for residential land use, describes development of site-specific preliminary remediation goals, and describes a plan for soil-lead cleanup at CERCLA sites. This guidance recommends using the EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) on a site-specific basis to assist in developing cleanup goals.
2. EPA Strategy for Reducing Lead Exposures	EPA, February 21,1991	Presents a strategy to reduce lead exposure, particularly to young children. The strategy was developed to reduce lead exposure to the greatest extent possible. Goals of the strategy are to (1) significantly reduce the incidence above 10 µg Pb/dL in children; and (2) reduce the amount of lead introduced into the environment.
3. Human Health Risk Assessment Report (HHRA)	"Human Health Risk Assessment, Southwest Jefferson County Mining Site, OU1, OU2, OU3, and OU5, Jefferson County, Missouri" - Prepared by HydroGeoLogic, Inc., May, 2012	Evaluates baseline health risk due to current site exposures and established contaminant levels in environmental media at the site for the protection of public health. The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contaminants in soils.
4. Superfund Lead-Contaminated Residential Sites Handbook	EPA OSWER 9285.7-50, August 2003	Handbook developed by EPA to promote a nationally consistent decision making process for assessing and managing risks associated with lead contaminated residential sites across the country.

Table 4
State Chemical-Specific ARARs

	Citations	Description
A. ARARs		
1. Missouri Air Conservation Law	Missouri Department of Natural Resources RSMo 643.010 10 CSR 10-6.010	Sets ambient air quality standards for a variety of constituents, including particulate matter and lead. Provides long range goals for ambient air quality throughout Missouri in order to protect the public health and welfare.
2. Hazardous Waste Management Law	Missouri Department of Natural Resources Identification and Listing of Hazardous Waste 10 CSR 25-4.261 (A) 1,2,4	Defines those solid wastes which are subject to regulations as hazardous wastes under 10 CSR 25.
3. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20 - 7.015 (1)(2)(3)(4)(5)(6)(7)(9)	Sets forth the limits for various pollutants which are discharged to the various waters of the state. Sets effluent standards that will protect receiving streams.
4. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20 - 7.031 (2)(3)(4)(5); Tables (A) (B)	Identifies beneficial uses of waters of the State, criteria to protect their uses, and defines the antidegradation policy.
B. To Be Considered	None	

Table 5
Federal Location-Specific ARARs

	Citations	Description
A. ARARs		
1. Historic project owned or controlled by a federal agency	National Historic Preservation Act: 16 U.S.C. 470, et.seq; 40 C.F.R. § 6.301;36 C.F.R. Part 1.	Property within areas of the Site is included in or eligible for the National Register of Historic Places. The remedial alternatives will be designed to minimize the effect on historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts.	Archeological and Historic Preservation Act; 16 U.S.C. 469, 40 C.F.R. 6.301.	Property within areas of the site may contain historical and archaeological data. The remedial alternative will be designed to minimize the effect on historical and archeological data.
3. Site located in area of critical habitat upon which endangered or threatened species depend.	Endangered Species Act of 1973, 16 U.S.C. 1531-1543; 50 C.F.R. Parts 17; 40 C.F.R. 6.302. Federal Migratory Bird Act; 16 U.S.C. 703-712.	Determination of the presence of endangered or threatened species. The remedial alternatives will be designed to conserve endangered or threatened species and their habitat; including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain soil.	Protection of Floodplains, Executive Order 11988;40 C.F.R. Part 6.302, Appendix A.	Remedial action may take place within a 100-year floodplain. The remedial action will be designed to avoid adversely impacting the floodplain in and around a potential future soil repository or residential actions to ensure that the action planning and budget reflects consideration of the flood hazards and floodplain management.
5. Wetlands located in and around the site.	Protection of Wetlands; Executive Order 11990; 40 C.F.R. Part 6, Appendix A.	Remedial actions may affect wetlands. The remedial action will be designed to avoid adversely impacting wetlands wherever possible including minimizing wetlands destruction and preserving wetland values.
6. Waters in and around the site.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230, 231.	Capping, dike stabilization, construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material. Five conditions must be satisfied before dredge and fill is an allowable alternative: 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. 5. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.

Table 5
Federal Location-Specific ARARs

	Citations	Description
A. ARARs		
7. Areas containing fish and wild habitat.	Fish and Wildlife Conservation Act of 1980, 16 U.S.C Part 2901 et seq.; 50 C.F.R. Part 83.9 and 16 U.S.C. Part 661, et seq.: Federal Migratory Bird Act, 16 U.S.C. Part 703.	Regulates activity affecting wildlife and non-game fish. Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
8. Fish and Wildlife Coordination Act.	16 U.S.C Section 661 et seq.; 33 C.F.R. Parts 320-330; 40 C.F.R. 6.302	Requires consultation when a Federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.
9. 100-year floodplain	Location Standard for Hazardous Waste Facilities- RCRA; 42 U.S.C. 6901; 40 C.F.R. 264.18(b).	RCRA hazardous waste treatment and disposal. Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout during any 100-year/24 hour flood.
10. Historic Site, Buildings, and Antiquities Act	16 USC Section 470 et seq., 40 C.F.R. Sect. 6.301(a), and 36 C.F.R. Part I.	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks and to avoid undesirable impacts on such landmarks.
B. To Be Considered	None	

Table 6
State Location-Specific ARARs

	Citations	Description
A. ARARs		
1. Missouri Wildlife Code	Missouri Department of Natural Resources 3 CSR Sec. 10- 4:111	Requires a determination of the presence or absence of endangered or threatened species, and provides for regulation of non-game wildlife. Places restrictions on actions affecting protected species. Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
B. To Be Considered	None	

Table 7
Federal Action-Specific ARARs

	Citations	Description
A. ARARs		
1. Disposal of Solid Waste in a Landfill or a Potential Future Soil Repository and Closure of a Potential Future Soil Repository.	Subtitle D of RCRA, 42 U.S.C. 6907 et seq. and 6941, et seq.	Implements State or Regional Solid Waste Plans and implements federal and state regulations to control disposal of solid waste. The yard soils disposed in the landfill or potential future repository may not exhibit the toxicity characteristic and therefore, are not hazardous waste. However, these soils may be solid waste. Contaminated residential soils will be consolidated from yards throughout the site into a single location. The disposal of this waste material should be in accordance with regulated solid waste management practices.
2. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life.
3. Clean Air Act	National Ambient Air Quality Standards/ NESHAPS 42 U.S.C. 74112; 40 C.F.R. 50.6 and 50.12	Emissions standards for particulate matter and lead.
4. Hazardous Materials Transportation Act	Hazardous Materials Transportation Regulations 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous materials.
5. Transportation of excavated soils.	DOT Hazardous Material Transportation Regulations, 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous wastes.
6. NPDES Storm Water Discharge.	40 C.F.R. Part 122.26; 33 U.S.C 402 (p)	Establishes discharge regulations for storm water.
7. Solid Waste Disposal Act	Hazardous Waste Management Systems General 40 C.F.R. Part 260 to 268	Establishes procedures and definitions pertaining to solid and hazardous waste.
8. Solid Waste Disposal Act	Identification and Listing of Hazardous Waste 40 C.F.R. Parts 261	Defines those solid wastes that are subject to regulations as hazardous wastes under 40 C.F.R. Parts 262-265 and Parts 124, 270, and 271.
9. Solid Waste Disposal Act	Standards Applicable to Generators of Hazardous Waste 40 C.F.R. Parts 262 to 262.11	Waste determination.
10. Solid Waste Disposal Act	Standards Applicable to Transporters of Hazardous Wastes 40 C.F.R. Parts 263	Establishes standards that apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 C.F.R. Parts 262.
11. Solid Waste Disposal Act	Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities 40 C.F.R. Parts 264 and 265	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities that treat, store, or dispose of hazardous waste.
12. Solid Waste Disposal Act	Land Disposal 40 C.F.R. Parts 268	Establishes a ban or restrictions on burial of wastes and other hazardous materials.

Table 7
Federal Action-Specific ARARs

	Citations	Description
A. ARARs		
13. Solid Waste Disposal Act	Hazardous Waste Permit Program 40 C.F.R. Parts 270	Establishes provisions covering RCRA permitting requirements.
14. Waters in and around the site.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230, 231.	Capping, dike stabilization, construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material. Four conditions must be satisfied before dredge and fill is an allowable alternative: 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. 5. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.
B. To Be Considered	None	

Table 8
State Action-Specific ARARs

	Citations	Description
A. ARARs		
1. Missouri Fugitive Particulate Matter Regulations	Missouri Department of Natural Resources 10 CSR 10-6.170	The Missouri fugitive particulate matter regulations contain restrictions on the release of particulate matter to ambient air. These regulations are applicable to any dust emissions that occur as a result of remedial actions taken. at the site.
2. Missouri Air Pollution Control Program	10 CSR 10-6.010 et seq.	Ambient concentrations of air pollutants should be less than their respective acceptable ambient levels at the site boundary.
3. Missouri Clean Water Law- Storm Water Regulations	Missouri Department of Natural Resources 10 CSR 20-6.200	These regulations define Best Management Practices for land disturbances, including practices or procedures that would reduce the amount of metals in soils and sediments available for transport to waters of the state. Permits would not be required for actions taken under CERCLA, but the substantive provisions of these regulations would be applicable. The Missouri standards would be considered ARARs only if they are more stringent than the Federal standards. Requires permits for metal and non-metal mining facilities and land uses or disturbances that create point source discharges of storm water.
4. Missouri Clean Water Law - Effluent Regulations	Missouri Department of Natural Resources RSMo 644.006-564 10 CSR 20 - 7.015	Regulates the discharge of constituents from any point source, including storm water, into waters of the state. Provides for the maintenance and protection of public health and aquatic life use of surface water and groundwater. The Missouri standards would be considered ARARs only if they are more stringent than the Federal standards. Regulates effluent discharges by limiting the amounts of various pollutants discharged to waters of the state. State permits would not be required under CERCLA, but the substantive provisions would be applicable.
5. Missouri Hazardous Substances Emergency Response	Missouri Department of Natural Resources RSMo 260.520 10 CSR 24-3.010	Establishes a state wide emergency telephone number to notify the State whenever a hazardous substance emergency occurs and specifies the requirements for emergency notification and follow up written notice.
6. Missouri Solid Waste Disposal Law	Missouri Department of Natural Resources RSMo 260.225 10 CSR 80-5.010(2)	Contains requirements for determining what solid wastes will be accepted at landfills and identifying any special handling requirements.
7. Missouri Solid Waste Disposal Law	Missouri Department of Natural Resources RSMo 260.225 10 CSR 80-5:010 (5) (A), (B) 1-4, (C)	Requires all waters discharged from solid waste processing facilities to be sufficiently treated to meet applicable water quality standards, including those established under the authority of the Federal Water Pollution Control Act.
8. Missouri Hazardous Waste Management Law Law	Missouri Department of Natural Resources RSMo 260.370 10 CSR 25-5.262	Sets forth standards for generators of hazardous waste, incorporates 40 CFR Part 262 by reference, and sets forth additional state standards.
9. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.385 and 260.395 10 CSR 25-6.263	Sets forth standards for transporters of hazardous waste, incorporates 40 CRF Part 263 and certain regulations in 49 CFR by reference, and sets forth additional state standards.
10. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.370, 260.390, and 260.395 10 CSR 25-7.264(2)(A) through (2)(G), (2)(K) through (2)(N), and/or (2)(S)	Sets forth the standards for owners and operators of hazardous waste treatment, storage and disposal facilities; incorporates and modifies the federal regulations in 40 CFR Part 264 by reference, and sets forth additional state requirements.
11. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.370, 260.390, 260.395, and 260.400 10 CSR 25-7.268	Establishes standards and requirements that identify hazardous wastes that are restricted from land disposal.
B. To Be Considered	None	

TABLE 9

ALTERNATIVE 2

Excavation up to 12 inches Below Ground Surface, Treatment via Stabilization (as needed), Disposal, Vegetative Cover, Health Education and Institutional Controls

COST ESTIMATE SUMMARY

Site: Southwest Jefferson County Mining Site
Operable Unit: OU1
Location: Jefferson County, Missouri
Phase: Feasibility Study
Base Year: 2012
Date: June 2012

Description: Alternative 2 provides protection of human health through remedial action to limit exposure, transport of contaminants and institutional controls. Residential properties that have or are expected to have soil lead concentrations above the cleanup level would be excavated. When the highest soil lead concentration in any sample collected on the property exceeds the cleanup level for lead greater than the cleanup level for lead, removal/excavated of soil up to 12 inches in depth would be triggered. Backfilling the excavated area with clean fill and top soil would follow, returning the property to its original elevation and grade. Excavation would continue in 6 inch increments until the soils at the bottom of the excavation exhibit lead levels below the cleanup level (as determined using XRF) or to a maximum depth of 12 inches bgs in yards, or 24 inches bgs in gardens. Additionally, the drip zones would be remediated if the lead concentration in the drip zone of the contaminated property exceeds the cleanup level. If the maximum depth of 12 inches, or 24 inches in the case of gardens, is excavated and lead concentrations still exceed the cleanup level an obvious plastic barrier would be installed as a warning that digging lower would result in possible exposure to soils contaminated at a level that EPA has determined to be a human health concern. For purposes of this FS it was assumed that excavated material would be hauled to a landfill for disposal; however, it may be hauled to a contaminated soil repository.

CAPITAL COSTS: (Assumed to be incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$27,397	$27,397	
Pre-Design Investigation	1	LS	$367,864	$367,864	Characterization of previously unsampled properties
Contractor Plans	1	LS	$61,000	$61,000	Includes quality assurance, sampling and analysis, and health and safety plans
Mobilization and Demobilization to Site	1	LS	$4,607	$4,607	
Air Monitoring - First Year	1	LS	$9,571	$9,571	Includes one-time purchase of equipment and sample analysis and management
Air Monitoring - Subsequent Years	4	EA	$6,191	$24,766	Air monitoring in construction years 1 through 4
Mobilization and Demobilization from Property to Property	800	EA	$519	$415,384	Total number of properties estimated that remain to be remediated.
Property Access	800	EA	$175	$139,656	
Excavation - Normal Access	211,200	BCY	$8.20	$1,731,840	
Excavation - Difficult Access	52,800	BCY	$14.05	$741,840	Approximately 20% will have difficult access and require longer to remediate.
Confirmatory Sampling	800	EA	$1,796	$1,436,632	Includes confirmatory sampling and cleanup report preparation.
Stabilization	495	TON	$647	$320,468	Includes stabilization material and mixing
Hauling	317,160	LCY	$11.69	$3,707,600	Hauling to landfill for disposal
Disposal	428,175	TON	$14.00	$5,994,450	Based on tipping fees
Restoration	264,000	ECY	$20.99	$5,541,360	Includes backfill with clean fill, seeding, and purchase of sprinkler with hoses
HEPA Vacuum Purchase	5	EA	$300.00	$1,500	Initial purchase cost of HEPA vacuums for loan program.
			SUBTOTAL	$20,525,935	
Contingency (Scope and Bid)	20%			$4,105,187	10% Scope, 10% Bid (Low end of the recommended range in EPA 540-R-00-002).
			SUBTOTAL	$24,631,122	
Project Management	5%			$1,231,556	Recommended range from EPA 540-R-00-002 was used.
Remedial Design	6%			$1,477,867	Recommended range from EPA 540-R-00-002 was used.
Construction Management	6%			$1,477,867	Recommended range from EPA 540-R-00-002 was used.
			TOTAL	$28,818,412	
			TOTAL CAPITAL COST	**$28,818,000**	Total capital cost is rounded to the nearest $1,000.

TABLE 9

ALTERNATIVE 2
Excavation up to 12 inches Below Ground Surface, Treatment via Stabilization (as needed), Disposal, Vegetative Cover, Health Education and Institutional Controls

COST ESTIMATE SUMMARY

Site: Southwest Jefferson County Mining Site
Operable Unit: OU1
Location: Jefferson County, Missouri
Phase: Feasibility Study
Base Year: 2012
Date: June 2012

Description: Alternative 2 provides protection of human health through remedial action to limit exposure, transport of contaminants and institutional controls. Residential properties that have or are expected to have soil lead concentrations above the cleanup level would be excavated. When the highest soil lead concentration in any sample collected on the property exceeds the cleanup level for lead greater than the cleanup level for lead, removal/excavated of soil up to 12 inches in depth would be triggered. Backfilling the excavated area with clean fill and top soil would follow, returning the property to its original elevation and grade. Excavation would continue in 6 inch increments until the soils at the bottom of the excavation exhibit lead levels below the cleanup level (as determined using XRF) or to a maximum depth of 12 inches bgs in yards, or 24 inches bgs in gardens. Additionally, the drip zones would be remediated if the lead concentration in the drip zone of the contaminated property exceeds the cleanup level. If the maximum depth of 12 inches, or 24 inches in the case of gardens, is excavated and lead concentrations still exceed the cleanup level an obvious plastic barrier would be installed as a warning that digging lower would result in possible exposure to soils contaminated at a level that EPA has determined to be a human health concern. For purposes of this FS it was assumed that excavated material would be hauled to a landfill for disposal; however, it may be hauled to a contaminated soil repository.

ANNUAL COSTS - PUBLIC OUTREACH (Years 0 through 4)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Public Outreach	1	LS	$30,000	$30,000	County educational outreach and maintenance of the HEPA vacuum loan program.
			SUBTOTAL	$30,000	
Contingency (Scope and Bid)	20%			$6,000	10% Scope, 10% Bid (Low end of the recommended range in EPA 540-R-00-002).
			SUBTOTAL	$36,000	
Project Management	10%			$3,600	The high end of the recommended range in EPA 540-R-00-002 was used.
			TOTAL	$39,600	
			TOTAL COST	**$40,000**	Periodic cost is rounded to the nearest $1,000.

ANNUAL COSTS - MAILINGS AND NOTICES (Years 0 through 4)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Annual Mailings and Notices	1	LS	$5,634	$5,634	
			SUBTOTAL	$5,634	
Contingency (Scope and Bid)	20%			$1,127	10% Scope, 10% Bid (Low end of the recommended range in EPA 540-R-00-002).
			SUBTOTAL	$6,761	
Project Management	10%			$676	The high end of the recommended range in EPA 540-R-00-002 was used.
			TOTAL	$7,437	
			TOTAL COST	**$7,000**	Periodic cost is rounded to the nearest $1,000.

TABLE 9

ALTERNATIVE 2
Excavation up to 12 inches Below Ground Surface, Treatment via Stabilization (as needed), Disposal, Vegetative Cover, Health Education and Institutional Controls

COST ESTIMATE SUMMARY

Site: Southwest Jefferson County Mining Site
Operable Unit: OU1
Location: Jefferson County, Missouri
Phase: Feasibility Study
Base Year: 2012
Date: June 2012

Description: Alternative 2 provides protection of human health through remedial action to limit exposure, transport of contaminants and institutional controls. Residential properties that have or are expected to have soil lead concentrations above the cleanup level would be excavated. When the highest soil lead concentration in any sample collected on the property exceeds the cleanup level for lead greater than the cleanup level for lead, removal/excavated of soil up to 12 inches in depth would be triggered. Backfilling the excavated area with clean fill and top soil would follow, returning the property to its original elevation and grade. Excavation would continue in 6 inch increments until the soils at the bottom of the excavation exhibit lead levels below the cleanup level (as determined using XRF) or to a maximum depth of 12 inches bgs in yards, or 24 inches bgs in gardens. Additionally, the drip zones would be remediated if the lead concentration in the drip zone of the contaminated property exceeds the cleanup level. If the maximum depth of 12 inches, or 24 inches in the case of gardens, is excavated and lead concentrations still exceed the cleanup level an obvious plastic barrier would be installed as a warning that digging lower would result in possible exposure to soils contaminated at a level that EPA has determined to be a human health concern. For purposes of this FS it was assumed that excavated material would be hauled to a landfill for disposal; however, it may be hauled to a contaminated soil repository.

ANNUAL COSTS - INSTITUTIONAL CONTROLS (Years 1 through 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Database Management	1	LS	$2,338	$2,338	
Long-Term Restoration Allowance	1	LS	$1,000	$1,000	
			SUBTOTAL	$3,338	
Contingency (Scope and Bid)	20%			$668	10% Scope, 10% Bid (Low end of the recommended range in EPA 540-R-00-002).
			SUBTOTAL	$4,006	
Project Management	10%			$401	The high end of the recommended range in EPA 540-R-00-002 was used.
			TOTAL	$4,407	
			TOTAL COST	$4,000	Periodic cost is rounded to the nearest $1,000.

FIVE-YEAR SITE REVIEW PERIODIC COSTS (Years 5, 10, 15, 20, 25, and 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	LS	$49,395	$49,395	
			SUBTOTAL	$49,395	
Contingency (Scope and Bid)	20%			$9,879	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$59,274	
Project Management	10%			$5,927	The high end of the recommended range was used.
			TOTAL	$65,201	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	$65,000	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each	LS	Lump sum
BCY	Bank cubic yard	QTY	Quantity
LCY	Loose cubic yard	TON	tons

TABLE 9

ALTERNATIVE 2
Excavation up to 12 inches Below Ground Surface, Treatment via Stabilization (as needed), Disposal, Vegetative Cover, Health Education and Institutional Controls

PRESENT VALUE ANALYSIS

Site:	Southwest Jefferson County Mining Site
Operable Unit:	OU1
Location:	Jefferson County, Missouri
Phase:	Feasibility Study
Base Year:	2012

Escalation Rate:	3.13%
Discount Rate:	6.00%

Year[1]	Capital Costs[2]	Annual O&M Costs	Annual Public Outreach Activities	Annual Institutional Control Costs	Periodic Five-year Review Costs	Total Annual Expenditure[4]	Escalation Factor	Escalated Cost[5]	Discount Factor	Present Value[6,7]
0	$5,763,600	$0	$40,000	$7,000	$0	$5,810,600	1.0000	$5,810,600	1.0000	$5,810,600
1	$5,763,600	$0	$40,000	$11,000	$0	$5,814,600	1.0313	$5,996,597	0.9524	$5,711,159
2	$5,763,600	$0	$40,000	$11,000	$0	$5,814,600	1.0636	$6,184,409	0.9070	$5,609,259
3	$5,763,600	$0	$40,000	$11,000	$0	$5,814,600	1.0969	$6,378,035	0.8638	$5,509,346
4	$5,763,600	$0	$40,000	$11,000	$0	$5,814,600	1.1312	$6,577,476	0.8227	$5,411,289
5	$0	$0	$0	$4,000	$65,000	$69,000	1.1666	$80,495	0.7835	$63,068
6	$0	$0	$0	$4,000	$0	$4,000	1.2031	$4,812	0.7462	$3,591
7	$0	$0	$0	$4,000	$0	$4,000	1.2408	$4,963	0.7107	$3,527
8	$0	$0	$0	$4,000	$0	$4,000	1.2796	$5,118	0.6768	$3,464
9	$0	$0	$0	$4,000	$0	$4,000	1.3197	$5,279	0.6446	$3,403
10	$0	$0	$0	$4,000	$65,000	$69,000	1.3610	$93,909	0.6139	$57,651
11	$0	$0	$0	$4,000	$0	$4,000	1.4036	$5,614	0.5847	$3,283
12	$0	$0	$0	$4,000	$0	$4,000	1.4475	$5,790	0.5568	$3,224
13	$0	$0	$0	$4,000	$0	$4,000	1.4928	$5,971	0.5303	$3,167
14	$0	$0	$0	$4,000	$0	$4,000	1.5395	$6,158	0.5051	$3,110
15	$0	$0	$0	$4,000	$65,000	$69,000	1.5877	$109,551	0.4810	$52,694
16	$0	$0	$0	$4,000	$0	$4,000	1.6374	$6,550	0.4581	$3,000
17	$0	$0	$0	$4,000	$0	$4,000	1.6887	$6,755	0.4363	$2,947
18	$0	$0	$0	$4,000	$0	$4,000	1.7415	$6,966	0.4155	$2,894
19	$0	$0	$0	$4,000	$0	$4,000	1.7960	$7,184	0.3957	$2,843
20	$0	$0	$0	$4,000	$65,000	$69,000	1.8523	$127,809	0.3769	$48,171
21	$0	$0	$0	$4,000	$0	$4,000	1.9102	$7,641	0.3589	$2,742
22	$0	$0	$0	$4,000	$0	$4,000	1.9700	$7,880	0.3418	$2,693
23	$0	$0	$0	$4,000	$0	$4,000	2.0317	$8,127	0.3256	$2,646
24	$0	$0	$0	$4,000	$0	$4,000	2.0953	$8,381	0.3101	$2,599
25	$0	$0	$0	$4,000	$65,000	$69,000	2.1609	$149,102	0.2953	$44,030
26	$0	$0	$0	$4,000	$0	$4,000	2.2285	$8,914	0.2812	$2,507
27	$0	$0	$0	$4,000	$0	$4,000	2.2982	$9,193	0.2678	$2,462
28	$0	$0	$0	$4,000	$0	$4,000	2.3702	$9,481	0.2551	$2,419
29	$0	$0	$0	$4,000	$0	$4,000	2.4444	$9,778	0.2429	$2,375
30	$0	$0	$0	$4,000	$65,000	$69,000	2.5209	$173,942	0.2314	$40,250
TOTALS:	**$28,818,000**	**$0**	**$200,000**	**$155,000**	**$390,000**	**$29,563,000**		**$31,822,479**		$28,416,413
TOTAL PRESENT VALUE OF ALTERNATIVE 2										**$28,416,000**

Notes:
1 - Estimated remedial timeframes are discussed within the FS report.
2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-2.
3 - Total annual expenditure is the total cost per year with no escalation or discounting.
4 - Escalation cost is the total cost per year including an escalation rate for that year. See Table PV-AERFT for details.
5 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.
6 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.
7 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.