APPENDIX A

Location ID	Property Address	Property City	Property Zip
EPA-8470	209 5th St.	Park Hills	63601
EPA-8471	213 5th St.	Park Hills	63601
EPA-7133 (DNR-153)	522 Park St.	Leadington	63601
EPA-7137 (DNR-171)	520 Union St.	Leadington	63601
EPA-7162 (DNR-230)	209 Sixth St	Park Hills	63601
EPA-224	113 Seventh St.	Park Hills	63601
EPA-225	704 East Main Street	Park Hills	63601
EPA-226	205 Henderson St.	Park Hills	63601
EPA-2680	306 Poe St.	Park Hills	63601
EPA-3377	219 Crane St.	Park Hills	63601
EPA-7014	205 Fourth St.	Park Hills	63601
EPA-8009	210 Crane St.	Park Hills	63601
EPA-8029	401 Sixth St.	Park Hills	63601
EPA-8037	406 Spruce St.	Park Hills	63601
EPA-8103	3565 College Rd.	Farmington	63640
EPA-9577	302 Reuter St.	Park Hills	63601
EPA-9659	302 Allen St.	Park Hills	63601
EPA-9660	303 Allen St.	Park Hills	63601
EPA-9661	217 First St.	Park Hills	63601
EPA-9726	412 Third St.	Park Hills	63601
EPA-9940	210 Reuter St.	Park Hills	63601
EPA-9991	212 Crane St.	Park Hills	63601

APPENDIX B

RECORD OF DECISION

BIG RIVER MINE TAILINGS SUPERFUND SITE

OPERABLE UNIT 1

FEBRUARY 2018

RECORD OF DECISION

BIG RIVER MINE TAILINGS SUPERFUND SITE
ST. FRANCOIS COUNTY, MISSOURI
CERCLIS ID#: MOD981126899
OPERABLE UNIT – 1

Prepared by:

U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, KS. 66101

September 2011

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RECORD OF DECISION

I. DECLARATION

A. SITE NAME AND LOCATION

Big River Mine Tailings Site, Operable Unit 1 (OU 1)
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID #: MOD981126899
St. Francois County, Missouri

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for addressing lead-contaminated residential and high child exposure area soil at the Big River Mine Tailings site (Site), OU 1. 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 (NCP). This decision is based on the Administrative Record (AR) for the Site. The AR is located at the following information repositories:

St. Francois County Health Center
1025 West Main Street
Park Hills, Missouri

U.S. Environmental Protection Agency,
Region 7 Records Center
901 North 5th Street
Kansas City, Kansas 66101

The United States Environmental Protection Agency (EPA) has coordinated the selection of this remedial action with the Missouri Department of Natural Resources (MDNR). The state of Missouri concurs with the Selected Remedy.

C. ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy focuses on the remediation of lead contaminated mine ore processing waste in residential areas of OU 1. For the purposes of this ROD, the term residential properties includes properties that contain single- and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, daycare centers, playgrounds, parks, and green ways. This cleanup action is one part of the EPA's overall efforts to cleanup environmental contamination resulting from historic lead mining operations at the Site. Cleanup activities of the original tailings piles (source areas) have already occurred and are nearly complete. The EPA believes that the Selected Remedy is protective of human health and the environment.

The Selected Remedy includes the excavation of residential soil until lead concentrations are below 400 parts per million (ppm) in the top 12 inches, or below 1,200 ppm below 12 inches down to 24 inches below ground surface (bgs), transportation of contaminated soil to on-site soil repositories, replacement of contaminated soil with clean backfill and vegetative cover and institutional controls (ICs). Any properties with lead-levels remaining above 1,200 ppm at depth would be subject to ICs. Further detail on the Selected Remedy can be found in Section I in the Decision Summary.

E. STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, is expected to comply with the chemical-, location-, and action-specific federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on OU 1, a review will be conducted within five years to ensure that the remedy continues to provide adequate protection of human health and the environment.

F. ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary of this ROD. Additional information can be found in the AR for this Site.

- Chemicals of concern and their respective concentrations
- Baseline risk represented by the chemicals of concern
- Cleanup levels established for chemicals of concern and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonably anticipated future land use assumptions
- Potential land use that will be available at the Site as a result of the selected remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected
- Key factors that led to selecting the remedy

G. AUTHORIZING SIGNATURE

Cecilia Tapia, Director
Superfund Division

9/30/11
Date

II. DECISION SUMMARY

A. SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Site (CERCLIS ID #: MOD981126899) is located in southeastern Missouri entirely within St. Francois County, approximately 70 miles southwest of St. Louis (Appendix A, Figure 1). The first recorded mining in St. Francois County occurred at Mine-a-Gabore between 1742 and 1762. Discoveries of disseminated lead in the Bonne Terre, Leadwood, and Flat River areas occurred in 1864. The introduction of the diamond drill in 1869 facilitated the discovery of additional reserves and output from the mines increased dramatically in the late 1800s. Mine output from St. Francois County peaked in 1942 when the concentrate equivalent of 197,430 tons of lead was produced. Mining ceased in the county in 1972 with the closing of St. Joe Lead Company's Federal mine.

The Site resides within the Old Lead Belt, which is on the northeastern edge of the Precambrian igneous core of the St. Francois Mountains. This area is one of the world's largest lead mining districts, having produced more than nine million tons of pig lead. It has been estimated that some 250 million tons of mill waste tailings and chat were produced in the Old Lead Belt from ore milling and beneficiation processes. The chat has been used extensively as aggregate for ballast in railroads, aggregate in concrete and asphalt, and fill. Some chat is used today as aggregate and fill. Tailings have been used as agricultural amendments due to the lime content.

Chat deposits include sand- to gravel-sized material resulting from the crushing, grinding, and dry separation of the ore material. Tailings deposits include sand- and silt-sized material resulting from the wet washing or flotation separation of the ore material. The mine waste contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These deposits may have contaminated soils, sediments, surface water, and groundwater. These materials also may have been transported by wind and water erosion or manually relocated to other areas throughout the county. It has been reported that mine waste may have been used on residential properties for fill material and private driveways, used as aggregate for road construction, and placed on public roads around St. Francois County to control snow and ice in the winter.

The EPA is the lead agency and MDNR is the support agency. The source of cleanup monies is mixed funding from potentially responsible party (PRP) settlements and the Superfund trust fund.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

To date, eight source areas of mine waste have been identified within the Site. These areas are shown on Figure 1 in Appendix A and are listed below:

- Desloge Pile (Big River Pile)
- National Pile
- Leadwood Pile
- Elvins Pile
- Bonne Terre Pile
- Federal Pile (St. Joe State Park)
- Doe Run Pile
- Hayden Creek

Part of EPA's overall strategy for the Site and St. Francois County was to address source control to reduce the continued transportation of mine waste. The sources of most of the lead contamination in the Site are the large mine waste piles listed above. For this reason EPA, with cooperation from some of the PRPs, began addressing the mine waste piles as removal actions before beginning remediation of residential properties.

Desloge Pile (Big River Pile)

In 1887, the Desloge Lead Company acquired the Bogy Tract (formerly Mine-a-Joe) near Desloge, Missouri, and commenced its operations under the name Desloge Consolidated Lead Company. In 1890 operations began in Shaft No. 1, originally sunk in 1873, by Bogy to a depth of 224 feet, and in 1893 the mill was started. By 1924, three shafts were operating with a fourth mill shaft being sunk so that ore could be hoisted directly into the crushing plant. The St. Joseph Lead Company took over the property in 1929 and operated it until 1958, when the Desloge mill shut down.

EPA and The Doe Run Resources Corporation entered into an Administrative Order on Consent in 1994 for a removal action to stabilize the Desloge Pile. Stabilization work on the Desloge Pile (Big River Pile) was mostly completed by 2000. Part of the site was left open for a Corrective Action Management Unit to store lead-contaminated soils on-site.

National Pile

In May 1898, the St. Louis Smelting and Refining Company (SLS&RC), a subsidiary of National Lead Company, purchased a block of land located near the Flat River station on the Mississippi River and Bonne Terre (MR&BT) railroad. The block included a working mine of the Flat River Lead Company (1,295 acres) and the old Taylor mines (900 acres). Shaft No. 1, sunk in 1893 by the Flat River Lead Company, was abandoned by SLS&RC. Shaft No. 2 was sunk in 1898, followed by Shaft No. 3 in 1899; and, the first SLS&RC ore produced from the property came in 1900. A state-of-the-art electric powered mill with a capacity of 1,200 tons per day was completed in 1901. Ore obtained from the mine (shafts) and several other small producers was milled, and concentrates were shipped to National Lead Company's Collinsville, Illinois, smelter. By 1910, four shafts had been sunk on the property. The property was sold to the St. Joseph Lead Company in 1933. St. Joseph Lead Company operated the National mine for several more years after the purchase but hauled the ore underground to the Federal mill.

EPA issued a Unilateral Administrative Order (UAO) in 2006 to the city of Park Hills, Missouri; The Doe Run Resources Corporation; NL Industries, Inc; and, the Park Hills Chamber of Commerce. The purpose of the UAO was for a time-critical-removal action to stabilize the National Pile. This work is ongoing and is projected to be completed by June 2012.

Leadwood Pile

The St. Joseph Lead Company's mining operations at Leadwood commenced in the Leadwood area as early as 1894. During 1903-1904, St. Joseph Lead Company constructed the Hoffman mill in Leadwood near Shafts Nos. 12 and 14, with a capacity of 1,000 to 1,200 tons per day. A concise description of the Hoffman concentrating plant operation is given in the Initial RI (Fluor Daniel 1995, page 2-74). Other

St. Joseph Lead Company mines in the area included Shaft No. 10 at Gumbo and Shaft No. 11, known as the Hunt, at the northeast edge of Leadwood near the Big River. The Leadwood mill was modernized periodically but ultimately closed by a strike in 1962.

EPA issued a Unilateral Administrative Order in 2006 to The Doe Run Resources Corporation for a removal action to stabilize the Leadwood Pile. The major earthwork at Leadwood was complete in June 2011. Remaining work includes the construction of passive bioreactors to treat dissolved zinc in groundwater seeps located at the east seep and erosion area and at the Leadwood Dam.

Elvins/Rivermines Pile

Flat River, Missouri, was the site of several mines and small concentrating works. A partial list of some of the companies with mining interests in the Flat River area (including the historic towns of Elvins, Central, St. Francois) included the Flat River Lead Company, Central Lead Company, The Doe Run Lead Company, Columbia Lead Company, Federal Lead Company, and Commercial Lead Company. In the early years, the milling operations were small and conducted at various locations. In 1891, The Doe Run Lead Company commenced mining in the Flat River area and subsequently acquired the properties of the Columbia Lead Company and Commercial Lead Company. By 1909, The Doe Run Lead Company controlled 6,548 acres in the Flat River area and carried on mining in seven shafts. In 1911, The Doe Run Lead Company consolidated its mill operations at Elvins to a 1,500 to 2,000 tons per day plant. The mill ceased operation in 1934. The property was acquired by St. Joe Minerals Corporation in 1936 when The Doe Run Lead Company was dissolved.

EPA issued a Unilateral Administrative Order in 2005 to The Doe Run Company for a time-critical-removal action to stabilize the Elvins/Rivermines Pile. All major earthwork was complete in June 2009. Remaining work includes the construction of passive bioreactors to treat dissolved zinc in a groundwater seep on the south end of the pile.

Bonne Terre Pile

The St. Joseph Lead Company was organized in 1864 and began mining operations at Bonne Terre in 1865 after purchasing the La Grave property. A mill was constructed and several shafts were sunk thereafter. In 1883, the Bonne Terre mill and associated works were destroyed by fire, after which a new and larger plant was constructed. The adjoining Desloge Lead Company mill, in operation since 1877, burned in 1884 and was subsequently purchased by the St. Joseph Lead Company. The smelter at Herculaneum was completed in 1892, and the furnaces from Bonne Terre were moved there. All Bonne Terre ore was smelted at Herculaneum thereafter.

EPA and The Doe Run Company entered into two Administrative Orders on Consent for the removal actions at the Bonne Terre Pile. The first was issued in 2001 and addressed the Western Portion of Bonne Terre. The second was issued in 2003 and addressed the Eastern Portion of Bonne Terre. All construction was complete in 2007.

Federal Tailings Pile

The Federal Lead Company, the corporate predecessor of the American Smelting and Refining Company (ASARCO), began operations in 1902 after acquiring various properties from the Irondale Lead Company, the Derby Lead Company, the Central Lead Company, the

Missouri Lead Fields Company, the Union Lead Company and others. In 1907, the Federal Lead Company constructed a large mill with a capacity of 3,000 tons per day (what is now the No. 3 mill at St. Joe State Park). A detailed inventory of shafts or mines operated by the Federal Lead Company (Buckley 1908) is presented in the Initial Remedial Investigation (Fluor Daniel 1995, page 2-58). By 1908, there were seven producing mines at the Federal Tailings Pile site and at least nine shafts, and by 1910, Federal Lead Company controlled 16,000 acres in St. Francois and Washington counties and was one of three major producers in the district with St. Joseph Lead Company and Doe Run. Milling operations were consolidated at the Federal mill in 1911. The Federal mill burned in 1912 and was reconstructed. In October 1923, the St. Joseph Lead Company purchased all of the Federal Lead Company holdings, including at least 12 shafts and the mill, which at that time was treating 4,800 tons per day. The Federal mill was permanently closed in 1970 when the mining operations in the area shifted to the Viburnum trend or New Lead Belt. St. Joe Minerals Corporation donated 8,561 acres to the state of Missouri for use as a park in 1975. The successor to the St. Joe Minerals Corporation was renamed The Doe Run Resources Corporation in 1994 and currently does business as The Doe Run Company.

EPA entered into an Administrative Settlement Agreement and Order on Consent for Removal Action with The Doe Run Resources Corporation and the state of Missouri Department of Natural Resources, Division of Parks in 2011 for stabilization of the Federal Pile. Work will be completed at Federal in 2013.

Doe Run Pile

The Doe Run Lead Company was organized in 1886 or 1887 and began operations in the town of Doe Run on the old Wm. R. Taylor tract. The Doe Run Lead Company sank two shafts, one 110 feet and the other 47 feet deep at the Doe Run property. About 1890, The Doe Run Lead Company acquired a tract of land in the Flat River area, and in 1907 acquired additional properties formerly owned by the Union Lead Company and the Columbia Lead Company. As of about 1908, The Doe Run Lead Company operated four shafts, two in the town of Doe Run and two in the Flat River area. By 1910, The Doe Run Lead Company had eleven shafts in the Flat River area. The property was acquired by St. Joe Minerals Corporation in 1936 when The Doe Run Lead Company was dissolved. St. Joe Minerals Corporation sold the site of the Doe Run Pile to an individual in 1977. The Doe Run Pile is approximately 24 acres in a rural area immediately south of the town of Doe Run.

The Doe Run pile has not been addressed. EPA plans to address this pile as part of Operable Unit 02 (OU 2).

Hayden Creek Mine

The Hayden Creek mine is located one mile southwest of the town of Frankclay. St. Joe Minerals Corporation discovered the ore body by random drilling in 1943. Underground development of the Hayden Creek or No. 22 Mine started in 1949 with the sinking of the shaft. Further development was undertaken in 1951 with limited mining in 1952. Mine production averaged about 1,000 tons of ore per day. A 1,200 ton-per-day magnetic separation mill was constructed but failed to operate satisfactorily; eventually all ore produced was trucked to St. Joseph Lead Company's Leadwood mill for processing. The Hayden Creek mine was closed in 1958, and the facilities were demolished.

Most material at Hayden Creek was addressed under the 2006 Unilateral Administrative Order for the Removal Action at Leadwood described above; however, Hayden Creek will be further assessed under OU 2 to determine if additional work is required to mitigate ecological risk.

Operable Units (OUs)

Currently there are four OUs designated at the Site that organize the work into logical elements based on removal criteria. This ROD addresses OU 1, lead contaminated mine ore processing waste in residential areas. Final RODs for the other OUs will be issued in the future.

OU 00 consists of the removal activities at the pile locations (Bonne Terre, Desloge, Leadwood, Federal, Elvins, and National).

OU 1 consists of the stabilization of the Desloge Pile (stabilized in 2000) and remediation of residential properties and high child exposure areas exceeding lead levels in residential soil of 400 ppm in St. Francois County and focuses on properties in the towns of Park Hills, Desloge, Bonne Terre, Leadwood, Leadington, and Doe Run; this also includes the rural residential properties surrounding these communities.[1]

OU 2 includes the remedial action to address terrestrial ecological risks and impacted watersheds associated with the mine wastes. OU 2 will also include future work on the Doe Run Pile.

OU 3 consists of the Interim Program and Halo Removal Action to address elevated blood lead at the Site. This included time-critical residential properties and high child exposure areas (i.e., playgrounds and daycare facilities).

History of Investigations

Over 100 years of lead mining left behind large piles of mine waste that dwarfed the towns of St. Francois County. Historical photos depicting mine waste piles are included in Appendix A as Figures 2 and 3. Mining operations in St. Francois County are estimated to have produced over 250 million tons of mine waste. Much of this waste was located in the eight major mine waste areas, identified above. Over twenty years ago, when EPA and the state of Missouri began investigations in St. Francois County, the mine waste piles were predominately barren of vegetation. Access to the waste piles was unrestricted. The waste piles were unstable and subject to wind erosion. A 1988 EPA inspection documented that dust from the Desloge Pile "created a suspended particulate plume" of lead-contaminated dust (Figure 4). Before the removal actions and stabilization of the mine waste piles, the Desloge Pile was 600 acres in size and up to 100 feet deep; Elvins was 149 acres and 170 feet higher than surrounding area; Bonne Terre (eastern portion) was 306 acres and up to 50 feet deep, Bonne Terre (western portion) was approximately 39 acres and about 160 feet higher than the surrounding area; the Federal tailings pile covers over 1,000 acres; and the Leadwood Pile was approximately 563 acres in size.

[1] The city of Park Hills was created recently when the former towns of Flat River, Esther, Rivermines, Frankclay, Wortham, and Elvins Combined.

EPA and the Missouri Department of Health and Senior Services (MDHSS) began investigating the Site in 1988. These investigations focused on the effects of the mine waste from the Desloge (Big River) Pile which was located adjacent to the Big River and as a result of rain fall and erosion had released lead mine waste into the Big River (Figure 5). In order to investigate a broader area, EPA performed a Listing Site Inspection in 1991 and a Site Assessment in 1992, which resulted in the Site listing on the National Priorities List (NPL) in 1992. The NPL is a national list of Superfund sites that prioritizes cleanups in order of the most serious contamination problems and greatest threats to human health and the environment.

The Site inspection and Site assessment identified potential sources of mine ore processing waste in the Big River watershed, determined the composition of these sources, and determined that there had been a release of mining-related contaminants (heavy metals) to media within the Big River watershed. The Site inspection and Site assessment also identified uses of mine waste in the area and provided analytical data on soil, tailings, sediment, air, surface water, and groundwater near the mine waste piles. Geographically, the Site investigation included the entire Site. A limited number of samples were collected from mine waste, groundwater, sediment, and soil, and were analyzed for heavy metals. Overall, the results indicated elevated concentrations of a number of heavy metals in samples of mine waste, groundwater, sediment, and soil.

Studies conducted by MDHSS including a Preliminary Public Health Assessment in 1994 and a lead exposure study in 1997 concluded that 17 percent of children tested in the mining area of St. Francois County had elevated levels of lead in their blood. A comparable city (Salem, Missouri) with similar aged housing stock was also studied and found to have an EBL rate of only 3 percent. As a result of the elevated blood lead levels in children, in 1997 and 1998, MDHSS followed the Exposure Study with the St. Francois and Jasper Counties Lead Intervention Study in 2000 as an effort to reduce the percentage of elevated blood leads in children at the Site.

In 1997, EPA entered into an Administrative Order on Consent for the development of the Remedial Investigation/Feasibility Study (RI/FS) with The Doe Run Resources Corporation and ASARCO Incorporated. The RI//FS was completed and released in 2011. The FS developed the alternatives for the remedial action for the residential properties. As part of the FS, an investigation of lead contamination in the subsurface soils was conducted. This investigation focused on the subsurface soils at 58 residential properties in the mining areas. Soil core samples were collected in 6-inch intervals, moving down in the soil profile to 30 inches bgs. The Subsurface Soil Report concluded that 7 percent of the yard quadrants after a 12 inch bgs excavation would have confirmation subgrade soil lead concentrations greater than 1,200 ppm.

The results of this Subsurface Investigation are part of the FS. The remedial alternatives developed and evaluated in the FS form the basis of this ROD. The FS is located in the AR for this Site.

In 2000, EPA entered into an Administrative Order on Consent with The Doe Run Resources Corporation, for implementation of a soil testing and removal program and blood lead testing and control program within the Site. This Order, called the Interim Program, provided that these programs would end when either EPA issued a ROD for residential yards or after four years. At the end of the Interim Program (March 30, 2004), 1,955 residential yards had been sampled and 563 homeowners had refused sampling, for a 78 percent sampling rate.

In 2004, EPA entered into another Administrative Order on Consent with The Doe Run Resources Corporation for a Removal Action to replace the expiring 2000 Interim Program. The 2004 Administrative Order was called the Halo Removal Order. The Halo Removal Order designated six of the mine waste areas in St. Francois County: National; Elvins; Bonne Terre; Federal; Desloge; and, Leadwood. The Halo Removal Order required removal actions within the halo around each of these waste areas. The halo was defined as the area within 500 feet of chat and tailings waste, 1,000 feet from four identified smelters/calciners, and 100 feet from mine shafts.

Under the Halo Removal Order 69 additional yards were sampled; of these 3 were parks, 5 were childcare facilities or school playground facilities, 29 were sampling refusals during the Interim Action, 17 were not within the Halo but were sampled due to the presence of a child with elevated blood lead levels, and the remaining 15 yards were primarily new construction within the Halo. Of the total yards sampled, 387 were completely remediated (all areas < 400 ppm) and 188 were partially remediated (part of the yard remains > 400 ppm).

EPA has also remediated seven schools, sixteen daycares, and two parks under removal authority.

C. COMMUNITY PARTICIPATION

The EPA issued the Proposed Plan for OU 1 on July 22, 2011, and provided a 30-day review and comment period opening on July 22, 2011. The public comment period was extended an additional 30 days and closed on September 21, 2011. A public meeting to present the plan and receive comments was held August 4, 2011, at the Mineral Area College from 6:00 pm to 8:00 pm. Included in this ROD in Appendix C is a Responsiveness Summary that addresses in writing the significant comments the EPA received from the public during the comment period.

D. SCOPE AND ROLE OF OPERABLE UNIT-1

This ROD sets forth the Selected Remedy for the response action and represents EPA's approach to address OU 1, residential properties and high child exposure areas at the Site. OU 1 includes lead-contaminated surface soils present at residential properties across the Site that have been contaminated as a result of migration of metal-bearing materials from past mining and ore processing practices via natural erosional processes, wind-blown mine waste, and human activities. EPA proposes to address the residential properties as the first remedial action to expedite cleanup of the areas that pose the greatest and most immediate threat to human health. This first remedial action for the Site is a continuation of the residential soil removal actions that have been ongoing in St. Francois County since the 2000 Interim Action. Additional remedial actions at the Site to address residual risk, such as actions for protection of the Big River watershed and stabilization of the Doe Run pile, will be addressed under future Proposed Plans and RODs.

The estimated total number of residential properties with lead-contaminated soil that will be addressed under this remedial action is approximately 4,000. This estimate is based upon the 1,000 contaminated properties sampled during the Interim Action that require remediation and an additional estimated 3,000 properties that have not been sampled but that potentially could exceed 400 ppm lead in soil.

As set forth below, the action level for lead in residential soil, 400 ppm, is based on the site-specific Human Health Risk Assessment (HHRA) and the site-specific blood lead study. This action level also assumes lead is measured in the bulk soil sample taken from the mid yard area with a X-Ray Spectrometer (XRF).

E. SITE CHARACTERISTICS

The Site is located within the Salem Plateau section of the Ozark physiographic province. The topography is hilly with several hundred feet of relief with altitudes ranging from about 700 to 1,000 feet above mean sea level. The climate in St. Francois County is continental with cold winters and hot summers. Annual precipitation is approximately 40 inches with a rainy season in fall and winter. Average annual snowfall is 13.7 inches. Prevailing winds are from the south.

The Site is located on the flanks of the St. Francois Mountains, a positive topographic structure in the southeast portion of the county composed of Precambrian granite and volcanic rocks. Cambrian sedimentary rocks are present above the Precambrian rocks and are, from oldest to youngest, the Lamotte Sandstone, Bonneterre Formation, Davis Shale, Derby-Doe Run Dolomite, Potosi Dolomite, and Eminence Dolomite.

The Bonneterre Formation is host to most of the ore bodies and is composed mostly of dolomite in the Old Lead Belt. The Bonneterre is 200 to 400 feet thick. The dolomite occurs as halos around igneous knobs that extend into or through the Bonneterre. Away from these igneous paleo-topographic highs, the Bonneterre is composed of unmineralized limestone. The lower 100 feet contain a variety of depositional structures where the richest ore was concentrated. The most abundant sulfide minerals in the Bonneterre Formation are galena, sphalerite, chalcopyrite, pyrite, and marcasite. Sphalerite (zinc ore) is restricted to certain areas of the district and is much less common than in the Tri-State Mining District of northeast Oklahoma, southwest Missouri, and southeast Kansas.

As indicated previously, past mining operations have left at least 8 identified major mine waste areas in the form of tailings and chat deposits from smelting and mineral processing operations in St. Francois County. Five of the mine waste deposits have been stabilized in place and there are plans in place to address the remaining areas. 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 may also have been transported by wind and water erosion or manually relocated to other areas throughout the county. It has been reported that mine waste may have been used on residential properties for fill material and private driveways, and as aggregate for road construction.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The primary land use within St. Francois County is agricultural crop and pasture land since mining operations have ended. Industrial activities consist of light manufacturing, aggregate production, and construction. The 2000 census indicated that the population of St. Francois County is 55,641 with most (55 percent) of the population living in Farmington, Park Hills, Desloge, and Bonne Terre. The city of Park Hills and the smaller towns of Leadwood, Leadington, and Doe Run are in the affected area. Future land use is expected to be primarily residential.

G. SUMMARY OF SITE RISKS

A Baseline HHRA was conducted for the Site by EPA in 2009 The HHRA assesses the potential risks to humans, both present and past, from Site-related contaminants present in environmental media including surface soil, indoor dust, sediment, surface water, groundwater, and fish tissue. The HHRA assumes that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. The results of the HHRA are intended to 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.

The HHRA identified lead as the primary contaminant of concern (COC) for OU 1. Other metals (zinc and cadmium) were identified in nonresidential soil and stream sediment and are considered COCs along with lead in OU 2. The focus of this ROD is the risk associated with lead because it is the primary COC for residential properties at OU1. For further information, please refer to the HHRA in the AR. Young children (typically defined as seven years of age or below) are the most sensitive population group potentially exposed to lead contamination at the Site. Young children are most susceptible to lead exposure because they have higher contact rates with soil and dust, absorb lead more readily than adults, and are more sensitive to the adverse effects of lead than older children and adults. The effect of exposure to lead contamination of greatest concern in children is impairment of the nervous system, including learning deficits, lowered intelligence, and adverse effects on behavior.

The risk for adverse health effects from exposure to lead contamination is 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, the risk of exposure to lead is based on consideration of total exposure (all pathways) rather than just site-related exposure. In addition, because most studies of lead exposures and the resultant health effects in humans have traditionally been described in terms of the resulting level of lead in the blood (expressed in micrograms/deciliter [µg/dl]), lead exposures and risks are typically assessed using mathematical models.

In determining the acceptable level to clean up soil in residential yards at the Site, the HHRA used EPA's Integrated Exposure Uptake Biokinetic (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. As set forth above, the focus of a risk assessment for lead in a residential setting is on children because they are a more sensitive population than older children or adults. Thus, the IEUBK model was used to evaluate the risks posed to young children (6 to 84 months) as a result of exposure to lead contamination at the Site.

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 basis for this goal is the Center for Disease Control and Prevention and EPA analyses demonstrating health effects at or above a blood lead level of 10 µg/dl.

The IEUBK model uses site-specific and default inputs (e.g., soil concentration, indoor dust concentration, bioavailability) to estimate the probability that a child's blood lead level might exceed 10 µg/dl.

For a residential child, the IEUBK model used available Site-specific data, including lead concentrations in residential property soil, indoor dust, and groundwater. In addition, testing was performed to estimate the relative bioavailability of the lead present at the Site. Bioavailability testing measures the amount of lead absorbed into the body following incidental ingestion of soil. The results indicate that bioavailability of lead at the Site is greater than the IEUBK model default value of 30 percent. Based on results of Site-specific measurements of *in vivo* bioavailability and *in vitro* bioaccessibility, the bioavailability of lead in soil and dust was estimated as 37 percent.

Exposure Pathways and Exposed Populations

Figure 6 presents the Conceptual Site Model (CSM) which shows a variety of exposure pathways by which Site-related COCs may migrate from on-site mine waste piles or contaminated surface soils acting as sources of contamination for other environmental media such as soil and indoor dust.

Risk Estimates for Residents from Soil

The IEUBK model was used to assess lead exposures to young children at the Site and within each community. Based on Site-specific information, EPA's IEUBK model predicts that a young child residing at the Site will have greater than a 5 percent chance of having a blood lead level exceeding 10 µg/dl if the lead soil concentrations to which he or she is exposed are above 337 ppm under the assumed exposure conditions. This is based on a Site-specific absolute bioavailability of 37 percent.

In addition to the modeling performed by EPA, one of the potentially responsible parties for the Site performed a Site-Specific Blood Lead Study. This study paired actual blood lead level measurements of 162 children with the corresponding residential yard soil lead concentrations. The study plotted actual blood lead levels with projected blood lead levels based on the Site-specific absolute bioavailability of 37 percent. The study also plotted the blood lead levels based on the default absolute bioavailability of 30 percent. The Blood Lead Study showed that a cleanup level of 400 ppm lead in residential soils would reduce risk to children to less than a 5 percent chance of having a blood lead level exceeding 10 µg/dl . Therefore, EPA has concluded that 400 ppm lead in residential yard soil will be the cleanup level of the remedial action as measured in the bulk soil fraction (sieving the soil sample with a #10 mesh sieve to obtain particles less than 2 millimeters) based on analysis with an XRF. Based upon this cleanup level, an estimated 4,000 homes at the Site are of potential health concern with regard to lead contamination to yard soil. This number is based on existing data which shows that 79 percent of properties sampled have lead levels greater than 400 ppm.

Risk Estimates for Residents from Groundwater

During the RI, 189 wells were sampled. Many of these wells were located close together in clusters. The results of this testing show no consistent lead contamination at these clusters and suggest no wide-spread impacts from lead mining at the Site to groundwater. Instead, elevated lead concentrations (lead > 15 µg/l) occur sporadically and were limited to 4 wells and could not be linked to the mining activities at the Site.

Further, groundwater concentrations fall within the range of those typical for drinking water in the area. Fifty-four percent of the wells tested were found to be at or below a lead concentration of 1 µg/l, and 85 percent were at or below the IEUBK model default of 4 µg/l. Further, 97 percent of the wells tested were at or below 15 µg/l, the level at which municipal supplies must attempt to reduce lead exposure.

Significantly elevated risks due to exposure to lead in groundwater appear to be limited to a small number of domestic well locations.

Summation

In past experience at Superfund sites where lead is the contaminant of concern, 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 criteria analysis included in this ROD and in accordance with the NCP. As described above, the IEUBK modeling results for the Site along with the Site-Specific Blood Lead Study recommend a lead soil concentration of 400 ppm to ensure that a child has less than a 5 percent probability of having a blood lead level exceeding 10 µg/dl.

This ROD only addresses human health risk at residential properties within the Site. Since this ROD only addresses human health, a summary of the Ecological Risk Assessment has not been included in the Selected Remedy. The Ecological Risk Assessment identified significant risk to ecologically sensitive areas and the natural environment. For example, elevated lead and zinc in the sediments and surface waters of Big River and Flat River Creek pose a significant risk to aquatic biota. Because of the lack of sensitive ecological receptors in the residential areas, the risk to the Big River, Flat River Creek and other identified risks to human health and the environment will be addressed in future cleanup decisions. For example, future EPA actions for OU 2 will address risk to ecological receptors and human health from lead-impacted non-residential soil, surface water, and sediment.

H. REMEDIAL ACTION OBJECTIVES

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. This ROD addresses the risk to human health resulting from exposure to residential soils contaminated with lead mine waste.

Based on current Site data and evaluations of potential risk, lead was identified as being a COC. The primary cause of human health risk from residential property soils at the Site is through direct ingestion (by mouth). Thus, the RAO for the residential property soils at the Site is to:

> **Reduce the risk of exposure of young children (children under seven years old) 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.**

Site-specific information, EPA's IEUBK model and the Site-Specific Blood Lead Study predict that a young child residing at the Site will have greater than a 5 percent chance of having a blood lead level exceeding 10 µg/dl if the lead soil concentrations to which he or she is exposed are above 400 ppm lead under the assumed exposure conditions. Thus, 400 ppm lead in soil will be the cleanup level of the remedial action as measured in the bulk soil fraction using an XRF instrument. As the lead agency, it is the current judgment of EPA that the Selected Remedy identified in this ROD is necessary to protect public health from actual or threatened releases of lead.

I. DESCRIPTION OF ALTERNATIVES

The FS evaluated three remedial action alternatives. The No Action alternative was evaluated; however, EPA believes that the No Action Alternative is not protective of human health and does not consider it a viable option. Each of the other two alternatives would require institutional controls to protect the remedy. The two action alternatives require sampling, excavation and disposal of lead contaminated residential yard soils with replacement of soil and reseeding of residential properties. The primary difference between the two action alternatives is the depth of the excavation. As set forth below, Alternative 3 is EPA's Selected Remedy. Each alternative is presented in much greater detail in the FS, which is part of the AR for the Site. The remedial alternatives developed to address the RAO previously identified in this ROD for the Site are presented below.

Alternative 1: No Action

Estimated Total Capital Cost: $0
Estimated Annual O&M Cost Range: $0
Estimated Present Worth Cost: $0
Estimated Construction Time Frame: zero months
Estimated Time to Achieve RAO: Infinite, RAO unachievable

The NCP requires that 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 contamination in residential property soil at the Site. Alternative 1 would not meet the RAO because it does not minimize or eliminate the existing or future human health risk at the Site.

Alternative 2: Soil Removal with 12 inch Subgrade Barrier and Institutional Controls

Estimated Total Capital Cost: $ 118.3 million
Estimated Annual O&M Cost Range: $0
Estimated Annual Health Education Cost: $20 thousand
Estimated Present Worth Cost: $ 97.72 million
Estimated Construction Time Frame: 7 years
Estimated Time to Achieve RAO: 7 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, and if applicable the drip zones, remediated. The drip zones would be remediated if the lead concentrations in the drip zone are ≥ 400 ppm. Residential properties where no quadrant samples exceed 400 ppm lead would not be addressed under this alternative. Under this alternative, EPA estimates that as many as 4,000 residential properties may contain lead soil concentrations greater than 400 ppm and will require remediation. This estimate is based on data from properties that have already been sampled. It is estimated that the soil at 4,540 residential properties at the Site has not been sampled for lead contamination. Under this alternative, all residential properties within the Site will be sampled for lead contamination. For more information please refer to the FS in the AR.

This alternative includes excavation and removal of lead-contaminated soil, backfilling the excavation with clean soil, and seeding. Excavation of a residential property would be triggered when the highest recorded soil sample for any defined area of the property contains ≥ 400 ppm lead. Soil would be

excavated using excavation equipment and hand tools in the portions of the property where the surface soil is ≥ 400 ppm lead. Excavation will continue 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 bgs, except for garden areas, where the maximum depth of excavation will be 24 inches bgs.

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 remedial actions 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. 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.

If at 12 inches bgs the lead soil concentration is ≥ 400 ppm, placement of a visual barrier will be required. The barrier placed will be a highly visible plastic barrier that is permeable, wide meshed, and will not affect soil hydrology or vegetation, such as an orange-mesh plastic sheet. The physical barrier will function as a warning that digging deeper will result in exposure to soils contaminated with lead at a level that EPA has determined to be a human health concern. A minimum of 12 inches of clean soil would be used as an adequate soil barrier 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.

Based on EPA's previous soil removal activities at the Site, EPA estimates that a total of approximately 1,247,000 cubic yards (yd^3) of soil would be required for excavation, disposal, and replacement. This alternative uses this quantity to develop the cost estimate.

Excavated soils will be transported in covered trucks to the soil repositories located at the Desloge (Big River) Pile and the Leadwood Pile (Figures 7 and 8, Appendix A). The contaminated soil will be placed in the soil repositories, capped with a clean 12 inch layer of soil, and revegetated with an appropriate seed mix. The placement of the contaminated soil will improve conditions at each of these mine waste piles by reducing the amount of wind-blown lead contaminated dust transported off the piles. It will also reduce water infiltration of the piles. The capacity of the soil repositories has not been determined but will be determined during the Remedial Design (RD). The O&M at the Big River Mine Tailings Pile will be implemented per the conditions of the 1994 Administrative Order on Consent (Docket # VII-94-F-0015). The O&M at the Leadwood Mine Tailings Pile will be implemented per the conditions of the 2006 Unilateral Administrative Order (Docket # CERCLA-07-2006-0272).

After replacement of topsoil at each residential property, the property will 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 can be established.

Health education is required under this alternative to reduce potential adverse health effects. An active educational program would be conducted in cooperation with EPA, the Agency for Toxic Substances

and Disease Registry (ATSDR), MDNR, MDHSS, and the St. Francois County Health Department. The educational activities would primarily be conducted by the St. Francois County Health Department. The following activities are examples of the types of education activities that may be conducted as part of this alternative:

- Extensive community-wide blood-lead monitoring.
- In-home assessments for children identified with elevated blood lead levels.
- Distribution of prevention information and literature.
- HEPA Vacuum cleaner loan program to houses subject to remediation.
- Outreach activities directed to area physicians.
- Community education meetings; and distribution of literature at such presentations at civic clubs, schools, nurseries, pre-schools, churches, fairs.
- Family assistance.
- Special projects to increase awareness of heavy metal health risks.

Institutional Controls (ICs): Alternative 2 requires institutional controls because lead contamination will remain at unlimited concentrations below 12 inches bgs. Based on the FS, approximately 12 percent, or 544, of the residential properties at the Site would remain contaminated with lead at levels above 400 ppm at 12 inches bgs. Additionally, 543 properties that were remediated during the Interim Program and Halo Removal Action remain contaminated above 400 ppm at 12 inches bgs and have barriers in place. Therefore, a total estimate of 1087 properties would be $\geq$ 400 ppm at 12 inches bgs and would be subject to ICs under Alternative 2.

EPA has historically required ICs to ensure a remedy's long-term protectiveness. At present, there are no applicable zoning ordinances in St. Francois County for residential properties. However, there are potential IC's that could be utilized. These include but are not limited to the following:

- Establishment of a registry of residential properties that have greater than 400 ppm lead in soil at 12 inches bgs with the St. Francois County Health Department.
- Yards subject to the ICs will also be extensively evaluated during each 5-year review to ensure protectiveness. This will ensure the remedy has remained protective.
- Building permit requirements that would involve pre-screening properties for lead.
- Builder and developer education programs for dealing with heavy metal soil contamination and best management practices for construction workers.
- Deed restrictions such as covenants or easements.

Future land use of the remediated residential properties is assumed to be residential. Under this alternative, land use will be enhanced because lead-contaminated soil will be removed from the remediated properties.

Alternative 3: Soil Removal with 24 inch Excavation with limited Institutional Controls

Estimated Total Capital Cost: $130.3 million
Estimated Annual O&M Cost Range: $0
Estimated Annual Health Education Cost: $20 thousand
Estimated Present Worth Cost: $107.62 million
Estimated Construction Time Frame: 7 years
Estimated Time to Achieve RAO: 7 years

Alternative 3 requires remediation of residential properties where a quadrant sample result shows ≥ 400 ppm lead. Excavation of a residential property would be triggered when the highest recorded soil sample for any defined area of the property contains ≥ 400 ppm lead. The entire drip zone will be remediated if the lead concentration in the drip zone is greater than 400 ppm. Residential properties where quadrant samples are < 400 ppm lead would not be addressed under this alternative.

Under this alternative, EPA estimates that approximately 4,000 residential properties may contain a quadrant with lead soil concentrations greater than 400 ppm and will require remediation. In contrast to the requirements for excavation in Alternative 2, Alternative 3 will require further excavation if the lead concentration is above 1,200 ppm at 12 inches. Excavation will continue until either a maximum depth of 24 inches; or underlying soils at the bottom of the excavation are below 1,200 ppm lead.

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 remedial actions 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. 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.

Based on the Subsurface Investigation, which is included in the AR, approximately 7 percent of the properties that are estimated to be above the action level, or 280, may be contaminated with lead at concentrations greater than 1,200 ppm at 12 inches bgs. For the Selected Remedy, the FS estimates that a total of approximately 1,280,000 yd^3 of soil would require excavation, disposal, and replacement. This estimate is used as the basis for the cost estimate for this alternative. As compared with Alternative 2, the excavation of an additional 33,000 yd^3 of soil at depth would result in a reduction of approximately 200 properties requiring some form of future IC. Alternative 3 requires placement of a visual barrier if at 24 inches bgs the lead soil concentration is greater than 1,200 ppm. The barrier placed will be an obvious plastic barrier that is permeable, wide meshed, and will not affect soil hydrology or vegetation, such as an orange-mesh plastic sheet. The physical barrier will function as a warning that digging deeper will result in exposure to soils contaminated at a level that EPA has determined to be a human health concern.

The application of the action level requires consideration of the depths of excavation and other risk management elements. Due to the distribution of lead contamination in the soil profile at the Site, EPA has determined that backfilling of excavated areas to original grade with clean material after reaching a

residual soil lead level less than 400 ppm in the upper 12 inches bgs, or a residual concentration of less than 1,200 ppm at a depth greater than 24 inches bgs, combined with other elements of the selected remedy, is protective of human health. These cleanup criteria are based upon a risk-management determination made by EPA in consideration of site-specific conditions at the Site and the experience gained in remediating thousands of properties using this strategy.

The 1,200 ppm cleanup level at depth is protective for occupational exposure of utility workers or other construction workers that could potentially contact subsurface soils following soil remediation. Disturbances could include installing or repairing water, sewer or natural gas lines, underground electrical, television or phone cables, fence and mail box posts, basketball poles and similar activities. It also could include planting trees or shrubs. For these types of disturbances, EPA's underlying premise is reasonable and would be protective of public health. The Selected Remedy is more protective than regulations promulgated under 40 CFR Part 745, which require:

> ...under the new standards, lead is considered a hazard when equal to or exceeding 40 micrograms of lead in dust per square foot on floors, 250 micrograms of lead in dust per square foot on interior window sills, and 400 ppm of lead in bare soil in children's play areas or 1,200 ppm average for bare soil in the rest of the yard.

In addition, Alternative 3 is consistent with the recommendations of the Superfund Lead-Contaminated Residential Sites Handbook (OSWER 9285.7-50, 2003). Five-year review procedures will apply to any eligible properties where soil remediation does not achieve the action or cleanup levels specified in this ROD.

As set forth above, EPA estimates that approximately 4,540 residential properties have not been sampled for lead contamination. Under this alternative, all residential properties within the Site will be sampled for lead contamination 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 remedial action.

ICs: ICs would be required on properties greater than 1,200 ppm lead at 24 inches bgs. The FS estimated that ICs would be applicable to approximately 2 percent, or 80 properties. Approximately 320 additional properties that were previously remediated to 12 inches bgs are $\geq$ 1,200 ppm and would be subject to ICs. Therefore, approximately 400 properties would be subject to ICs under Alternative 3. ICs are the same as Alternative 2 described above.

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

J. COMPARATIVE ANALYSIS OF ALTERNATIVES

Summary of the Comparative Analysis of Alternatives

The NCP, 40 CFR. part 300, requires EPA to evaluate remedial alternatives against nine criteria to determine which alternative is preferred. This analysis is performed during the FS. The detailed analysis in the FS provides an in-depth analysis of the three alternatives compared against the nine criteria. The

FS is available in the AR for the Site. An alternative must satisfy all nine criteria before it can be selected. The first step is to meet the threshold criteria, which are overall protection of public health and the environment and compliance with ARARs. In general, alternatives that do not satisfy these two criteria are rejected.

The second step is to compare the alternatives against a set of balancing criteria. The NCP establishes five balancing criteria which include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; implementability; short-term effectiveness; and cost. The third and final step is to evaluate the alternatives on the basis of modifying criteria, which are state and community acceptance.

Threshold Criteria

The following presents a brief description of whether and how the alternatives satisfy the threshold criteria of overall protection of public health and the environment and compliance with ARARs.

Overall Protection of Human Health and the Environment

This criterion provides an overall assessment of whether an alternative meets the requirement that it is protective of human health and the environment. This criterion considers whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment. This ROD focuses on risk to human health. Ecological risk will be addressed under OU 2.

Alternative 1 does not provide protection for human health and the environment at the Site because of the continued risk to residents of the Site. Alternative 1 does not meet the RAO identified for this Site. Lead contaminated residential soil will continue to pose exposure risk for an indefinite period.

Alternative 2 provides protection to human health by removing the significant exposure pathway associated with contaminated residential property soils. Alternative 2 would meet the RAO for the Site once excavation, soil replacement, and revegetation is complete, and the removed soils are properly disposed, enforceable ICs are implemented, and an effective health education program is implemented. Risks associated with lead-contaminated residential property soil will be mitigated.

Alternative 3 is protective of human health by addressing the risks associated with lead contaminated residential soil. Alternative 3 is more protective of human health than Alternative 2 because Alternative 3 requires removal of soil below 12 inches bgs if the soil is contaminated above 1,200 ppm lead. Alternative 3 requires removal of contaminated soil to a maximum depth of 24 inches bgs. Alternative 3 would also meet the RAO for the Site. Alternative 3 would reduce the number of properties that would require ICs by an estimated 587 properties. ICs are potentially difficult to implement on residential properties. The FS showed that by excavating beyond 12 inches bgs and to a maximum depth of 24 inches bgs, approximately 98 percent of the properties that have not yet been addressed will have safe lead concentrations and will not be subject to ICs. Because there are fewer residential properties contaminated at depth below 12 inches, fewer visual barriers would be required to be installed under Alternative 3.

Compliance with ARARs

This criterion is used to determine whether an alternative meets federal and state ARARs as defined by section 121 of CERCLA, 42 U.S.C. § 9611. Compliance is judged with respect to chemical-specific, action-specific, and location-specific ARARs as well as to be considered (TBC) requirements that include nonpromulgated criteria, advisories, guidance and proposed standards issued by federal or state governments. The ARARs for this ROD are included in attached Tables 2 through 4.

Alternative 1 does not comply with ARARs because this alternative does not take any action to mitigate the risk associated with lead. Compliance with ARARs would be met if EPA assumes that no disturbance of contaminated soil occurs in the future; however, this would be an unreasonable assumption due to the maintenance and construction activities that are routine practice at residential areas.

In contrast, Alternative 2 and Alternative 3 would comply with chemical and location-specific ARARs because they both address the risk by eliminating the direct exposure to lead-contaminated soil.

Alternatives 2 and 3 will also meet the action-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 excavation, soil 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 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.

Balancing Criteria

The following presents a brief description of how the alternatives developed in the FS satisfy the balancing criteria.

Long-term Effectiveness and Permanence

This criterion addresses the results of a cleanup action in terms of the risk remaining at the Site after the goals of the cleanup have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

Alternative 1 provides no long-term effectiveness or permanence for the protection of human health and the environment. Alternative 1 provides no controls to manage residual risk associated with lead contamination to soil at residential properties. Under Alternative 1, residual risks to human health would remain at or near current levels.

Under Alternative 2 and Alternative 3, the residual risks (the risk remaining after implementation) would be significantly reduced. Under both Alternative 2 and Alternative 3, the residual risk is the lead contamination left in place at depth after the completion of the remedy. This risk is managed by clean soil cover and use of a visual barrier to warn of the remaining contamination. While both Alternative 2

and Alternative 3 manage the residual risk in this manner, Alternative 3 would provide the most long-term effectiveness and permanence because any remaining lead contamination (>1,200 ppm) would be covered with a 24 inch barrier of clean soil compared to the 12 inch barrier of clean soil in Alternative 2.

A significant aspect of Alternative 2 and Alternative 3 is the placement of the contaminated soils at the Desloge Pile (Big River Pile) and Leadwood Pile Soil Repositories. The repositories would require storm water controls and other design and engineering controls for long-term stability.

Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contaminants. This criterion evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Under Alternative 1 there is no reduction in the toxicity, mobility, or volume of contamination because lead contaminated soils are left in place.

Alternatives 2 and 3 would significantly reduce the mobility of the COC by transporting and consolidating the lead contaminated soils from the residential yards and high child exposure areas at the Desloge Pile (Big River Pile) and Leadwood Pile Soil Repositories. Contaminated soil would be placed at the repositories in designated areas that are not prone to erosion. After placement, the contaminated soil would be capped with clean soil, less than 400 ppm, and revegetated. The cap thickness and seed mix for revegetation will be determined during the final design. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced by these alternatives. Proper long-term maintenance of the designated repositories is an important component of Alternatives 2 and 3 to ensure the significant reduction of heavy metal mobility.

Alternatives 2 and 3 do not utilize treatment to address the threats posed by the residential property soils. The residual waste found in the residential soils is considered a low-level threat waste, which is defined as surface soil containing contaminants of concern that generally is relatively immobile in air or ground water in the specific environmental setting (Office of Solid Waste and Emergency Response (OSWER), Publication 9380.3-06FS, 1991).

Additionally, 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. Various phosphate compounds have been used at the Viburnum Tailings Pile site and the Oronogo-Duenweg Mining Belt site to treat mine waste and lead-contaminated soil. In both cases the phosphate compounds were shown to be an ineffective and unfeasible alternative when compared to soil removal and replacement.

Short-term Effectiveness

This criterion addresses the effects of the alternative during the construction until the remedial action is completed and the selected level of protection has been achieved.

Alternative 1 does not create any short term risk to the local community or workers because no work will be performed under Alternative 1. Alternative 1 also does not create any short term risk of environmental impact during construction since there is no construction under this alternative. Exposure pathways for the public and environment would remain.

Alternatives 2 and 3 have increased risks to the local communities and workers, as well as the environment from excavation and transportation of lead contaminated soil. Short-term community protection concerns are similar under both Alternative 2 and 3, and include possible fugitive dust emissions and heavy metal ingestion. Disturbed contaminated soil could enter the ambient air during excavation and transportation. Dust suppression would be implemented for the protection of the community and workers during the remedial action. Alternatives 2 and 3 would require a minimum of 7 years to implement for all affected residences. However, the length of time at any one residence during excavation would be minimal. Therefore, the residential exposure to dust would be minimal.

Implementability

This criterion addresses the technical and administrative feasibility of implementing a cleanup and the availability of various services and materials required during its implementation.

Alternative 1 does not require any implementation.

Alternative 2 and Alternative 3 are readily implementable because they are technically feasible from an engineering perspective. Excavation methods, backfilling, and revegetation are typical engineering controls. The experience gained from previous Site removal actions conducted by EPA at this and other lead mining Superfund sites has shown that Alternative 2 and Alternative 3 are readily implementable.

Cost

This criterion addresses the direct and indirect capital cost of the remedy. O&M costs incurred over the life of the project, as well as present worth costs, are also evaluated.

No capital or O&M costs would be associated with Alternative 1 because no remedial actions would be conducted.

The present worth cost for Alternative 2 is estimated to be $97.72 million.

The present worth cost for Alternative 3 is estimated to be $107.62 million.

For the cost estimates for both Alternative 2 and 3, capital costs are spread over a period of 30 years. A 7 percent discount rate was used to calculate the present worth. These estimates are approximate and made without detailed engineering data. The actual cost of the remedial action would depend on the final scope of the remedial action, actual length of time required to implement the alternative, and other unknown factors.

The historical average amount of soil removed from each property is 305.19 yd^3, on a 12 inch excavation. These estimates are averages of past construction activities on this Site but future costs could well vary. Annual costs of $20,000 are estimated for public health education. Additional information on cost can be found in Tables 5 and 6 of Appendix B.

Modifying Criteria

The two modifying criteria of community and state acceptance are intended to assess the views of both groups regarding the Alternatives. EPA conducts meetings with representatives from MDNR, MDHSS, ATSDR, St. Francois County Health Department, news media, visiting academics and students, and local citizens to address activities and policies at the Site on a regular basis.

State/Support Agency Acceptance

MDNR supports the Selected Remedy (Alternative 3) proposed by EPA. MDNR has commented on and concurs with the Selected Remedy.

Community Acceptance

During the public comment period, the community expressed its support for Alternatives 2 and 3. A Responsiveness Summary (which captures public comments) is included in Appendix C.

K. PRINCIPAL THREAT WASTE

Principal threat wastes are source materials that require remediation based on toxicity, mobility, and the potential to create unacceptable human health or ecological risks. The NCP establishes a preference that treatment will be used to address principal threat wastes when practical.

The eight mine waste piles are the source deposits and constitute the principal threat to human health and the environment. This threat is being addressed by stabilizing the mine waste deposits in place, which includes regrading and covering the mine waste deposits with clean rock and/or soil. The eight mine waste piles either are, or are in the process of being, covered with clean soil and revegetated as part of removal actions at the Site. In place stabilization of the mine waste deposits provides adequate protection when combined with ICs, such as site access restrictions (fences, rock barriers, etc.). In addition, removal or treatment of the very large mine waste deposits (>5,000,000 cubic yards) is impracticable.

The residual waste found in the residential soils is considered a low-level threat waste, which is defined as surface soil containing contaminants of concern that generally are relatively immobile in air or ground water in the specific environmental setting (OSWER, Publication 9380.3-06FS, 1991). However, the residual waste in soil has the potential to be a principal threat waste when it is mobilized by mechanical means, therefore, remediation is necessary to mitigate the potential risk.

L. SELECTED REMEDY

The Selected Remedy is Alternative 3 — Excavation of soil until lead concentrations are below 400 ppm in the top 12 inches; or below 1,200 ppm below 12 inches down to 24 inches bgs; transportation of contaminated soil to on-Site soil repositories; replacement of contaminated soil with clean backfill, vegetative cover and limited institutional controls.

The Selected Remedy was chosen over the other alternatives by EPA based on the nine NCP criteria set forth above. The Selected Remedy provides the best balance of trade-offs and achieves the RAO. A primary consideration is the significant reduction in the number of properties that would require difficult to implement ICs as a result of the more extensive excavation (to a depth of 24 inches bgs) which would be required at a relatively small number of properties.

M. STATUTORY DETERMINATIONS

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) utilize 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 RAO through conventional engineering measures. Risks associated with lead-contaminated residential soils at the Site are caused by the potential for direct contact with contaminated soils. The Selected Remedy eliminates this direct exposure pathway through excavation and replacement of lead-contaminated soils at the residential properties. Contaminated soils will be removed from residential properties, permanently eliminating this identified source of exposure. The implementation of the Selected Remedy will not pose unacceptable short-term risks or cross-media impacts.

Compliance with ARARs

In general, Selected Remedies should comply with ARARs unless waivers are granted. The Selected Remedy is expected to meet all chemical-specific, action-specific, and location-specific ARARs and does not involve any waivers. The ARARs for this ROD are included in Tables 2 through 4 in Appendix B.

Cost Effectiveness

The Selected Remedy is a cost-effective solution to lead-contaminated residential soils at the Site. The Selected Remedy relies on conventional engineering methods that are easily implemented. Contaminated soils are removed and replaced, thereby providing a permanent remedy for remediated residential soils which will not be subject to future costs.

Utilization of Permanent Solutions and Alternate Treatment Technologies

The Selected Remedy utilizes a well-demonstrated remediation approach to lead-contaminated soils that will provide a permanent remedy for residential properties. Removal and replacement of contaminated residential soils permanently removes heavy metal contaminants as a potential source of exposure. Since all contaminated soil will remain on-site, lead stabilization treatment is not required to prevent the soils from failing the Toxicity Characteristic Leaching Procedure (TCLP) test. The Selected Remedy best satisfies the statutory mandates for permanence.

Preference for Treatment

The Selected Remedy does not utilize treatment to address the threats posed by the residential property soils. The residual waste found in the residential soils is considered a low-level threat waste, which is defined as surface soil containing contaminants of concern that generally is relatively immobile in air or ground water in the specific environmental setting (OSWER, Publication 9380.3-06FS, 1991).

Additionally, 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. Various phosphate compounds have been used at the Viburnum Tailings Pile site and the Oronogo-Duenweg Mining Belt site to treat mine waste and lead-contaminated soil. In both cases the phosphate compounds were shown to be an ineffective and unfeasible alternative when compared to soil removal and replacement.

Under the Selected Remedy for this Site, contaminated soil will be placed on the existing repositories located at the Desloge Pile (Big River Pile) and Leadwood Pile. The contaminated soil will be placed on the repositories, capped with a clean 12 inch layer of soil, and revegetated with a site-specific seed mix. The placement of the contaminated soil will improve conditions on the mine waste piles by reducing the amount of wind-blown lead contaminated dust transported off the piles and will also reduce water infiltration of the piles. Since contaminated soil will remain on-Site, treatment is not required to prevent the soils from failing the TCLP test.

Five-Year Review Requirements

The selected remedy is subject to periodic five-year reviews in accordance with Section 121(c) of CERCLA and the NCP. Although mining wastes will be removed from the residential yards and placed in the existing repositories, waste will remain onsite at elevated levels in a small amount of the yards below 24 inches bgs and in the repositories. The status and effectiveness of the ICs will be evaluated during the 5-year review process.

APPENDIX A

FIGURES

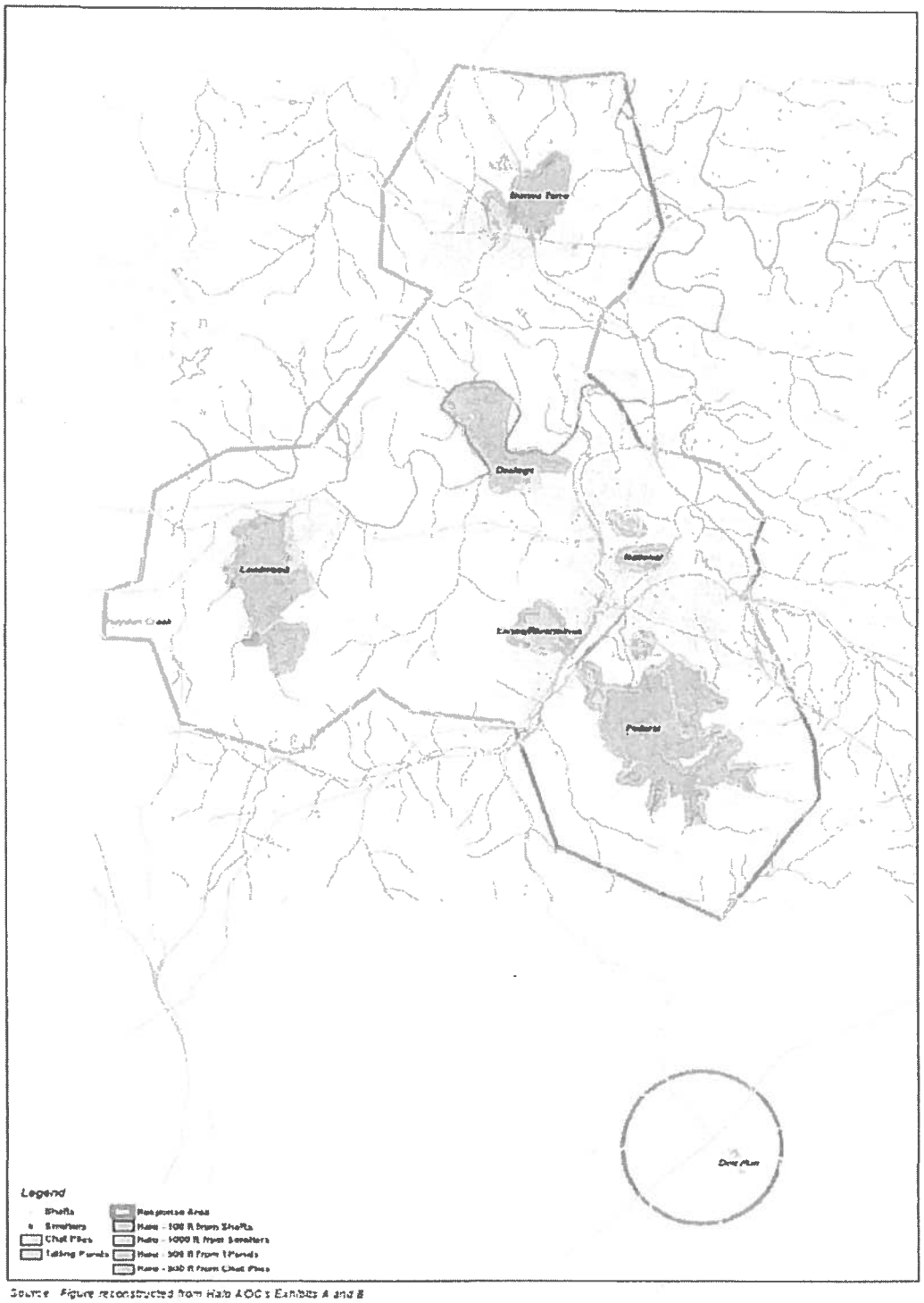

Figure 1
Response Area and Halo
St. Francois Co. Mined Areas

Figure 2. National Pile Before Remediation

Figure 3. Bonne Terre Pile Before Remediation

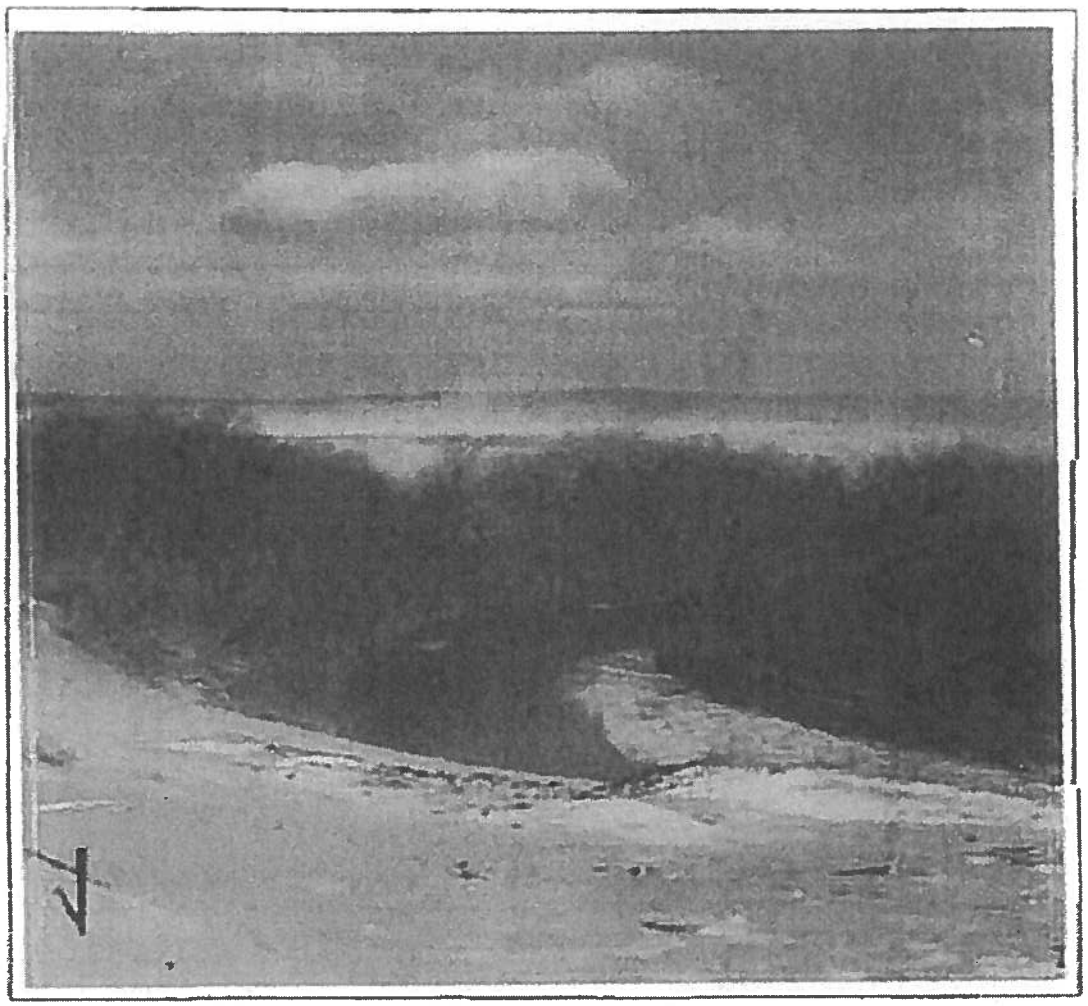

Figure 4. Visible Mine Waste blowing off the Desloge Pile

Figure 5. Visual erosion of Mine Waste into Big River

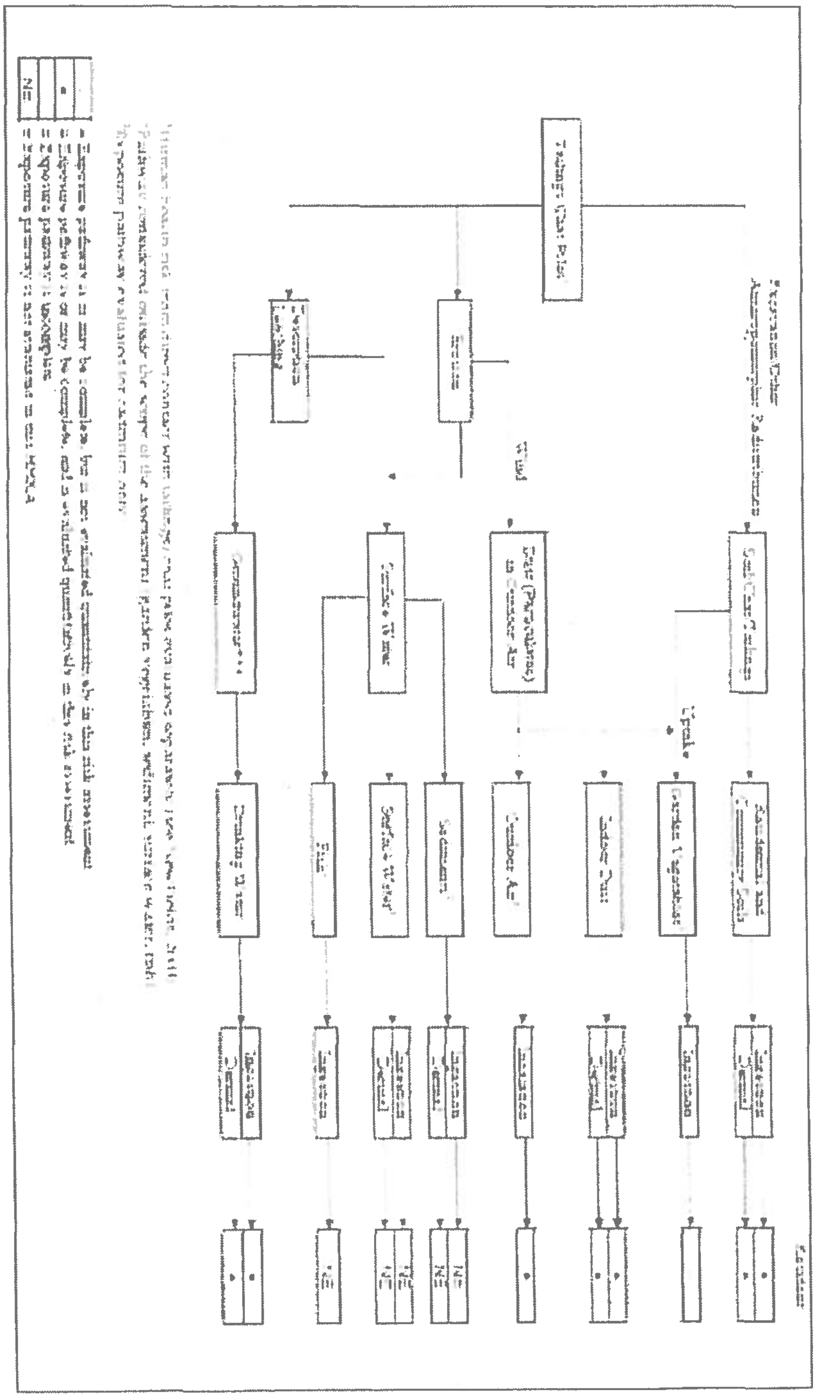

Figure 6. Conceptual Site Model

Figure 7. Big River (Desloge) Repository

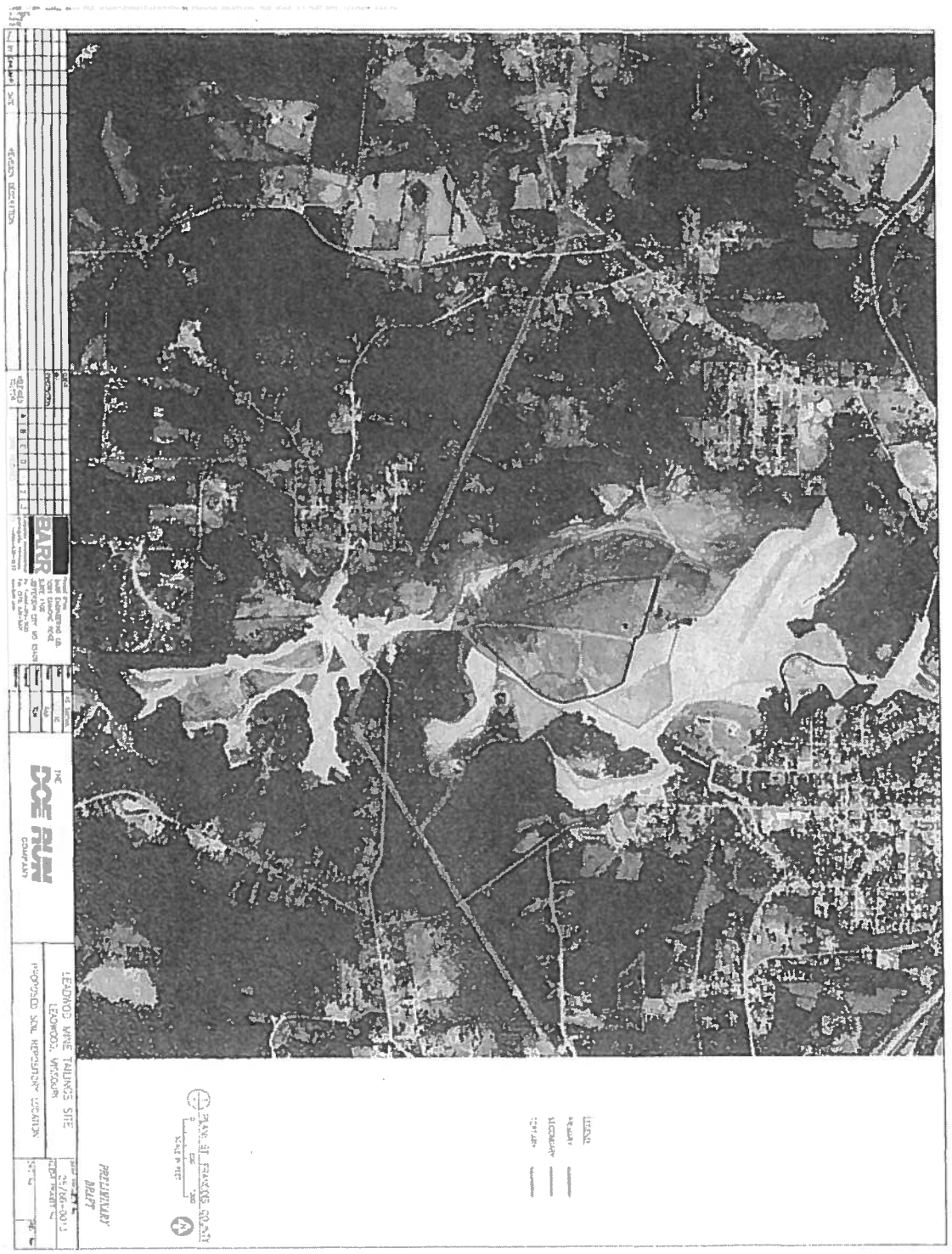

Figure 8. Leadwood Repository

APPENDIX B

TABLES

TABLE 1. ST. FRANCOIS COUNTY 2000 CENSUS INFORMATION

City/Community	***Population***
Farmington	13,924
Park Hills	7,861
Desloge	4,802
Bonne Terre	4,039
Bismarck	1,470
Leadwood	1,160
Iron Mountain Lake	693
Leadington	206
Balance of St. Francois County	21,486

Source: United States Census Bureau, 2001

TABLE 2. FEDERAL AND STATE CHEMICAL SPECIFIC ARARs

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Hazardous Waste Criteria	Potentially	–	40 CFR 264	Establishes criteria for use in determining hazardous wastes and disposal requirements. Excavated soil would be classified as D008 hazardous waste if the lead concentration from the TCLP test was greater than 5.0 mg/L.	Would be applicable if hazardous wastes are generated and disposed of off-site at a RCRA Facility. All excavated yard soils would be disposed of in an onsite CAMU. This regulation would potential apply if any of the wastes were disposed of off-site.
National Ambient Air Quality Standards (NAAQS)	No	Yes	40 CFR Part 50	Establishes ambient air quality standards for certain "criteria pollutants" to protect public health and welfare. Standard is: 0.15 microgram lead per cubic meter ($\mu g/m^3$) maximum – arithmetic mean averaged over a rolling 3 month average.	NAAQS are implemented through the New Source Review Program and State Implementation Plans (SIPs). The Federal New Source Review Program addresses only major sources. Emissions associated with the remedial action would be limited to fugitive dust emissions associated with earth moving activities during construction. These activities will not constitute a major source. Therefore, attainment and maintenance of NAAQS pursuant to the New Source Review Program are not applicable. However, the standards relating to lead are relevant and appropriate.
STATE					
Missouri Ambient Air Standards	Yes	–	Missouri Code of State Regulations (CSR) 10 CSR 010-06.010	Missouri uses the NAAQS as the state standards for airborne emissions. The NAAQS air quality standards for particulates, as PM10, are 50 $\mu g/m^3$ (annual geometric mean) and 150 $\mu g/m^3$ (24 hour), as PM2.5 they are 15 $\mu g/m^3$ (annual geometric mean) and 65 $\mu g/m^3$ (24 hour). The NAAQS emission limit for lead is 0.15 $\mu g/m^3$ averaged over a rolling 3 month average.	Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.

TABLE 3. LOCATION - SPECIFIC ARARs

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Archaeological and Historic Preservation Act	No	No	16 USC Sec. 469	Establishes procedures to provide for preservation of historical and archaeological data that might be destroyed through alteration of terrain as a result of a Federally licensed activity or program.	Area to be part of soil remedial activities is not believed to contain any historical or archaeological resources due to residential nature of Site and shallow depth (<2 ft) of excavation activities to be performed (if necessary).
Archaeological Resources Protection Act	No	No	16 USC Secs. 470 aa - mm	Requires permits for any excavation or removal of archaeological resources from public or Indian lands. Provides guidance for federal land managers to protect such resources.	Activities will not take place on public land or Indian land.
National Historic Preservation Act	No	No	16 USC Sec. 470 36 CFR Part 800 Executive Order 11593, May 3, 1971	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for Register of Historic Places.	Area to be part of soil remedial activities is not believed to contain any feature that would be eligible for registration as a historic place due to residential nature and location of Site.
Historic Sites, Buildings, and Antiquities Act	No	No	16 USC Secs. 461 - 467, 470h-2(f)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Area to be part of soil remedial activities is not believed to contain any National Natural Landmarks due to residential nature and location of Site.
Fish and Wildlife Coordination Act	No	No	16 USC Secs. 661 - 666	Requires any Federal agency or permitted entity to consult with the U.S. Fish and Wildlife Service and appropriate state agency prior to modification of any stream or other water body. The intent of this requirement is to conserve, improve, or prevent loss of wildlife habitat and resources.	Area to be part of soil remedial activities is not believed to directly impact any stream or water feature. However, streams adjacent to properties could be potentially affected by runoff from remedial activities.
Fish and Wildlife Conservation Act	No	No	16 USC Secs. 2901 - 2912	Requires Federal agencies to utilize their statutory and administrative authority to conserve and promote conservation of non-game fish and wildlife species.	Area to be part of soil remedial activities is not believed to directly impact any stream or water feature. However, streams adjacent to properties could be potentially affected by runoff from remedial activities.

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
Endangered Species Act	No	No	16 USC Secs. 1531-1544 50 CFR Parts 17, 402	Requires that Federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Area to be part of soil remedial activities is not believed to directly impact any critical habitat. Remedial activities will be restricted to residential properties and are not expected to adversely impact listed species.
Federal Migratory Bird Treaty Act	No	No	16 USC Secs. 703 - 712	Prohibits taking of any migratory bird.	Area to be part of soil remedial activities is not believed to directly impact any critical habitat. Remedial activities will be restricted to residential properties and not expected to adversely impact migratory birds.
Executive Order on Floodplain Management	No	No	Executive Order No. 11988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	Remedial activities to be performed are comprised of restoration of residential properties. As such, no additional development within the floodplain is anticipated beyond that previously performed during the original development of the property.
Executive Order on Protection of Wetlands	No	No	Executive Order No. 11990	Requires Federal agencies to avoid, to the maximum extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid new construction in wetlands, if a practicable alternative exists.	Remedial activities to be performed are comprised of restoration of residential properties. As such, no adverse impacts on wetlands are anticipated.
Farmland Protection Policy Act	No	No	7 USC Sec. 4201 *et. seq.*	Protects significant or important agricultural lands from irreversible conversion to uses that result in its loss as an environmental or essential food production resource.	Remedial activities to be performed are comprised of restoration of residential properties and are not expected to impact agricultural lands. As such, no loss of environmental or essential food production resources is anticipated.

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
RCRA – Location Standards for Hazardous Waste Facilities	Potentially	–	42 USC Sec. 6901 40 CFR 264.18	Requires that any hazardous waste facility located within the 100-year floodplain be designed, constructed, operated, and maintained to avoid washout. Also, contains requirements for locating facilities away from seismically active zones. Because most mining and mill wastes are explicitly excluded from RCRA regulations, these requirements are only TBCs for the Site.	All excavated yard soils will be disposed of in an onsite CAMU – BRMTS Repository. This unit, located on a designated mine area, is managed in accordance with the CAMU Approval Memorandum dated December 12, 2001 and the Operation Manual (NewFields 2003).
Rivers and Harbors Act	No	No	33 CFR Secs. 320 - 330	Requires preapproval of the US Army Corps of Engineers prior to placement of any structures in waterways and restricts the placement of structures in waterways.	Area to be part of soil remedial activities is not believed to directly impact any navigable stream or water feature or necessitate placement of any structures within these features.
STATE					
Missouri Hazardous Waste Regulations	--	Potentially	10 CSR 25-7.264 - 270	Hazardous waste disposal areas shall not be placed within a 100-year floodplain or wetland. Provisions related to placement and management of hazardous waste units.	Relevant and appropriate to actions that generate hazardous waste. All excavated yard soils will be disposed of in an onsite CAMU – BRMTS Repository. This unit, located on a designated mine area, is managed in accordance with the CAMU Approval Memorandum dated December 12, 2001 and the Operation Manual (NewFields 2003).
Missouri Metallic Minerals Waste Management Act	--	Yes	10 CSR 45	Actions involving placement of metallic mineral waste shall be performed according to permit.	All excavated yard soils will be disposed of in an onsite CAMU – BRMTS Repository. This unit, located on a designated mine area, is managed in accordance with the CAMU Approval Memorandum dated December 12, 2001 and the Operation Manual (NewFields 2003).

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
Missouri Solid Waste Regulations	Potentially	--	11 CSR 80-11.010	Actions involving solid waste disposal areas shall not cause degradation to wetlands or jeopardize existence of endangered or threatened species protected under the Endangered Species Act of 1973 or violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972.	Relevant and appropriate to actions that generate solid waste. All excavated yard soils will be disposed of in an onsite CAMU – BRMTS Repository. This unit is managed in accordance with the CAMU Approval Memorandum dated December 12, 2001 and the Operation Manual (NewFields 2003).

TABLE 4. FEDERAL AND STATE ACTION - SPECIFIC ARARs

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Hazardous and Solid Waste: Criteria for Classification of Solid Waste and Disposal Facilities and Practices	Yes	--	40 CFR Part 257	Establishes criteria for use in determining solid wastes and disposal requirements.	Excavated soil is a solid waste.
1. Criteria for Classification of Hazardous Waste and Disposal Facilities and Practices	Potentially	--	40 CFR Part 264	Establishes criteria for use in determining hazardous wastes and disposal requirements.	All excavated yard soils will be disposed of in an onsite CAMU – BRMTS Repository. This unit, located on a designated mine area, is managed in accordance with the CAMU Approval Memorandum dated December 12, 2001 and the Operation Manual (NewFields 2003). This regulation would potential apply if any of the wastes were disposed of off-site.
2. Hazardous Materials Transportation Regulations	Potentially	--	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Applicable only if the remedial action involves off-site transportation of hazardous materials: The regulations affecting packaging, labeling, marking, placarding, using proper containers, and reporting discharges of hazardous materials would be potential ARARs.

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
Air Emission Control: 1. National Ambient Air Quality Standards (NAAQS)	No	Yes	40 CFR Part 50	Establishes ambient air quality standards for certain "criteria pollutants" to protect public health and welfare. Standards are: 150 $\mu g/m^3$ for particulate matter for a 24 hour period; 50 $\mu g/m^3$ for particulate matter – annual arithmetic mean; 0.15 $\mu g/m^3$ maximum – arithmetic mean averaged over a 3 month rolling average.	NAAQS are implemented through the New Source Review Program and State Implementation Plans (SIPs). The federal New Source Review Program addresses only major sources. Emissions associated with the remedial action would be limited to fugitive dust emissions associated with earth moving activities during construction. These activities will not constitute a major source. Therefore, attainment and maintenance of NAAQS pursuant to the New Source Review Program are not applicable. However, the standards relating to particulate matter and to lead are relevant and appropriate.
STATE					
Hazardous and Solid Waste: 1. Solid waste determination	Yes	--	Missouri Solid Waste Regulations 11 CSR 80-11	A solid waste is any discarded material that is not excluded by Regulation.	Applicable to soil excavated from residential yards.
2. Determination of hazardous waste.	Potentially	--	Missouri Hazardous Waste Regulations 10 CSR 25-7.264 - 270	If an extract from a solid waste, tested using the Toxicity Characteristic Leaching Procedure (TCLP, Test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods", EPA publication SW 846), contains concentrations of any of the materials above the listed level (5 mg/L for lead), the waste is considered hazardous.	Applicable to soil excavated from residential yards and disposed of offsite. All excavated yard soils would be disposed of in an onsite CAMU.

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
3. Transportation of Hazardous Waste	Potentially	–	Missouri Solid Waste Regulations 11 CSR 80-11	Rules regarding Transportation of Hazardous Substances.	Applicable only if the remedial action involves off-site transportation of hazardous materials. The regulations affecting packaging, labeling, marking, placarding, using proper containers; and reporting discharges of hazardous materials would be potential ARARs.
Air Emission Control: 1. Particulate emissions during excavation and backfill.	Yes	–	Missouri Code of State Regulations 10 CSR 010-06	Missouri air pollution regulations require persons that emit fugitive particulates to minimize emissions through use of all reasonable precautions. In addition, no visible fugitive dust transport is allowed beyond the lot line of the property where the emissions originate.	Applicable to actions that entail excavation, moving, storing, transportation of redistribution of soil.
2. Ambient Air Standard for Total Suspended Particulate Matter	No	Yes	Missouri Code of State Regulations 10 CSR 010-06	Missouri uses the NAAQS as the state standards for airborne emissions. The NAAQS air quality standards for particulates, as PM_{10}, are 50 $\mu g/m^3$ (annual geometric mean) and 150 $\mu g/m^3$ (24 hour), as $PM_{2.5}$ they are 15 $\mu g/m^3$ (annual geometric mean) and 65 $\mu g/m^3$ (24 hour).	Remedial activities will not constitute a major source and therefore regulations are not applicable. Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.
3. Ambient Air Standards	No	Yes	Missouri Code of State Regulations 10 CSR 010-06	Missouri uses the NAAQS as the state standards for airborne emissions. Excavation and backfill of soils could potentially cause emission of hazardous air pollutants. The NAAQS emission limit for lead is 0.15 $\mu g/m^3$ averaged over a rolling 3 month average.	Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
Storm water Controls:					
1. Storm water NPDES Permit	No	Yes	Missouri Clean Water Commission 10 CSR 020-06	Missouri has established General NPDES Storm Water Permit for a land disturbance site such as would be encountered during the soil remedial action at the Site. The permit requires the establishment of best management practices (BMP) to control runoff.	This project is being performed under CERCLA as an Emergency Removal Action and therefore does not require a permit. However, the substantive requirements of the Missouri General Permit will be implemented at the site including CBMP, routine inspections and record keeping.

Table 5

Detailed Cost Estimate
Alternative 2 - Soil Removal with 12-Inch Subgrade Visual Barrier
St. Francois County Mined Areas - Residential Feasibility Study

Item/Description		Quantity		Est. per each costing unit	Costing Unit Quantity	Unit	Unit Cost	Total Cost
CAPITAL COSTS								
Sampling								
Sampling and Analysis								
Access		4,540	properties		148	days	$680.00	$100,640
Education Materials		4,540	properties		4,540	property	$1.50	$6,810
Sampling		3,587	properties		180	days	$1,700.00	$306,000
Sampling Analysis					36	days	$1,700.00	$61,200
XRF					1	XRF	$15,500.00	$15,500
Calibration Samples to Analytical Laboratory		897	samples		897	sample	$28.00	$25,116
Data Management		4,540	properties		227	hours	$95.00	$21,565
Result Letter Mailing		3,587	properties	150 letters per	24	mailings	$711.00	$17,064
Best Effort Letters for Sampling Refusal		954	properties	48 letters per	20	mailings	$909.00	$18,180
SUBTOTAL DIRECT CAPITAL COSTS - Sampling								***$572,075***
Sampling								
Mob/Demob							10%	$57,208
Engineering/Administration Costs							10%	$57,208
Health & Safety							3%	$17,162
SUBTOTAL INDIRECT CAPITAL COSTS - Sampling								***$131,577***
TOTAL ESTIMATED CAPITAL COST SAMPLING								**$703,652**
Removal								
Interim Action Sampled Yards (Known Yards)		1,001	properties					
Removal Access								
Access and Property Documentation	100%	1,001	properties		1,001	properties	$75.00	$75,075
Best Effort Letters for Refusals	14%	140	letters		140	letters	$5.50	$770
Excavation & Placement of Clean Fill		1,001	properties	Even though 14% of all yards are expected to refuse access, the cost assumes 100% participation				
Yard Quadrants/Areas		2,471						
One Quad		218	properties	3,000	654,000	SF	$2.87	$1,876,980
Two Quads		242	properties	6,000	1,452,000	SF	$2.11	$3,063,720
Three Quads (yards reduced by 2011 yards)		295	properties	9,000	2,655,000	SF	$2.11	$5,602,050
Four Quads (yards reduced by 2011 yards)		221	properties	12,000	2,652,000	SF	$1.63	$4,322,760
Driveway								
With yard quads								
One Quad		18	areas	1,000	18,000	SF	$2.87	$51,660
Two Quads		16	areas	1,000	16,000	SF	$2.11	$33,760
Three Quads (yards reduced by 2011 yards)		18	areas	1,000	18,000	SF	$2.11	$37,980
Four Quads (yards reduced by 2011 yards)		25	areas	1,000	25,000	SF	$1.63	$40,750
Only		15	areas	1,000	15	LS	$2,870.00	$43,050
Garden (assumes 24 inch depth excavation)		Gardens are assumed to be located in excavated quads in properties with more than two quads removed; therefore,						
With yard quads		Only 12 to 24 inch excavation included when 3 or 4 yard quadrants are remediated						
One Quad		6	areas	625	3,750	SF	$5.74	$21,525
Two Quads		8	areas	625	5,000	SF	$4.22	$21,100
Three Quads (yards reduced by 2011 yards)		15	areas	625	9,375	SF	$2.11	$19,781
Four Quads (yards reduced by 2011 yards)		18	areas	625	11,250	SF	$1.63	$18,338
Only		4	areas	625	4	LS	$2,870.00	$11,480
Play Area								
With yard quads		Play areas are assumed to be located in excavated quads in properties with more than two quads removed						
One Quad		15	areas	150	2,250	SF	$2.87	$6,458
Two Quads		27	areas	150	4,050	SF	$2.11	$8,548
Only		5	areas	150	5	LS	$2,870.00	$14,350
Final Close-out documentation		1,001	properties		1,001	properties	$75.00	$75,075
Lawn Watering (Known Yards)		1,001	properties	7,420,050 SF	2,315,056	gallons	$2.80 /1000 gal	$6,019
Non-Interim Action Sampled Yards (Potential)		Percent estimates based on the above known yards						
Removal Access		3,012	properties	Assumes 84% of sampled properties will require some soil removal				
Access and Property Documentation	100%	3,012	properties		3,012	properties	$37.50	$112,950
Best Effort Letters for Refusals	14%	421	letters		421	letters	$5.50	$2,316
Excavation & Placement of Clean Fill		3,012	properties	Even though 14% of all yards are expected to refuse access, the cost assumes 100% participation				
Yard Quadrants/Areas		8,581	quads					
One Quad (17%)	17%	512	properties	3,000	1,536,000	SF	$2.87	$4,408,320
Two Quads (19%)	19%	572	properties	6,000	3,432,000	SF	$2.11	$7,241,520
Three Quads (26%)	26%	783	properties	9,000	7,047,000	SF	$2.11	$14,869,170
Four Quads (38%)	38%	1,144	properties	12,000	13,728,000	SF	$1.63	$22,376,640
Driveway								
With yard quads								
One Quad	8%	40	areas	1,000	40,000	SF	$2.87	$114,800
Two Quads	7%	40	areas	1,000	40,000	SF	$2.11	$84,400
Three Quads	6%	62	areas	1,000	62,000	SF	$2.11	$130,820
Four Quads	11%	125	areas	1,000	125,000	SF	$1.63	$203,750
Only	1.2%	36	areas	1,000	36,000	SF	$2.87	$103,320
Garden (assumes 24 inch depth excavation)		Gardens are assumed to be located in excavated quads in properties with more than two quads removed; therefore,						
With yard quads		Only 12 to 24 inch excavation included when 3 or 4 yard quadrants are remediated						
One Quad	3%	15	areas	625	9,375	SF	$5.74	$53,813
Two Quads	3%	17	areas	625	10,625	SF	$4.22	$44,838
Three Quads	5%	28	areas	625	17,500	SF	$2.11	$36,925
Four Quads	8%	45	areas	625	28,125	SF	$1.63	$45,844
Only	0.3%	9	areas	625	9	LS	$2,870.00	$25,830
Play Area								
With yard quads		Play areas are assumed to be located in excavated quads in properties with more than two quads removed						
One Quad	7%	35	areas	150	5,250	SF	$2.87	$15,068
Two Quads	11%	62	areas	150	9,300	SF	$2.11	$19,623
Only	0.4%	12	areas	150	12	LS	$2,870.00	$34,440

Table 5

Detailed Cost Estimate
Alternative 2 - Soil Removal with 12-Inch Subgrade Visual Barrier
St. Francois County Mined Areas - Residential Feasibility Study

Item/Description	Quantity		Est. per each costing unit	Costing Unit Quantity	Unit	Unit Cost	Total Cost
Final Close-out documentation	3,012	properties		3,012	properties	$75.00	$225,900
Lawn Watering (Potential Additional Yards)	3,012	properties	25,759,350 SF	8,036,917	gallons	$2.60 /1000 gal	$20,898
SUBTOTAL DIRECT CAPITAL COSTS - Known Yards							$15,351,226
SUBTOTAL DIRECT CAPITAL COSTS - Potential Additional Yards							$50,171,181
SUBTOTAL DIRECT CAPITAL COSTS - Removal							*$65,522,407*
Interim Action Sampled Yards (Known Yards)							
Mob/Demob						10%	$1,535,123
Engineering/Administration Costs						10%	$1,535,123
Construction Management Costs						10%	$1,535,123
Health & Safety						3%	$460,537
Non-Interim Action Sampled Yards (Potential)							
Mob/Demob						10%	$5,017,118
Engineering/Administration Costs						10%	$5,017,118
Construction Management Costs						10%	$5,017,118
Health & Safety						3%	$1,505,135
SUBTOTAL INDIRECT CAPITAL COSTS - Known Yards							$5,065,905
SUBTOTAL INDIRECT CAPITAL COSTS - Potential Additional Yards							$16,556,490
SUBTOTAL INDIRECT CAPITAL COSTS - Removal							*$21,622,394*
Scope and Bid Contingencies - Removal only						35%	$30,500,680
TOTAL ESTIMATED CAPITAL COST REMOVAL							$117,645,481
TOTAL ESTIMATED CAPITAL COST (SAMPLING AND REMOVAL)							*$118,349,133*
ANNUAL O&M COSTS							
None							
PERIODIC COSTS							
Five-Year Review							$75,156
Sampling and Analysis = resampling surface soils at remediated properties (5 years x 574 yards/yr) at a 5% rate						$20,158	
Access	144	properties	1	days	$680.00	$680.00	
Sampling	144	properties	8	days	$1,700.00	$13,600.00	
Sampling Analysis			2	days	$1,700.00	$3,400.00	
Calibration Samples to Analytical Laboratory	36	samples	36	sample	$28.00	$1,008.00	
Data Management	144	properties	8	hours	$95.00	$760.00	
Result Letter Mailing	144	properties	1	mailings	$708.14	$708.14	
Summary of Removal Action to date					1	$55,000	
Remedial Action Report						$75,000	*$75,000*
TOTAL ESTIMATED PERIODIC COST							*$150,156*
TOTAL NON-DISCOUNTED COST							***$118,499,289***
TOTAL PRESENT WORTH (7% rate of return, 30 year period)							***$97,719,000***

NOTES:

Cost Assumptions are provided in Appendix A

Total Present Worth calculation presented in Table A-1

Table 6

Detailed Cost Estimate
Alternative 3 - Soil Removal with 24-Inch Excavation
St. Francois County Mined Areas - Residential Feasibility Study

Item/Description		Quantity		Est. per each costing unit	Costing Unit Quantity	Unit	Unit Cost	Total Cost
CAPITAL COSTS								
Sampling								
Sampling and Analysis								
Access		4,540	properties		148	days	$680.00	$100,640
Education Materials		4,540	properties		4,540	property	$1.50	$6,810
Sampling		3,587	properties		180	days	$1,700.00	$306,000
Sampling Analysis					36	days	$1,700.00	$61,200
XRF					1	XRF	$15,500.00	$15,500
Calibration Samples to Analytical Laboratory		897	samples		897	sample	$28.00	$25,116
Data Management		4,540	*properties*		227	*hours*	$95.00	$21,565
Result Letter Mailing		3,587	properties	150 letters per	24	mailings	$711.00	$17,064
Best Effort Letters for Sampling Refusal		954	properties	48 letters per	20	mailings	$909.00	$18,180
SUBTOTAL DIRECT CAPITAL COSTS - Sampling								***$572,075***
Sampling								
Mob/Demob							10%	$57,208
Engineering/Administration Costs							10%	$57,208
Health & Safety							3%	$17,162
SUBTOTAL INDIRECT CAPITAL COSTS - Sampling								***$131,577***
TOTAL ESTIMATED CAPITAL COST SAMPLING								**$703,652**
Removal								
Interim Action Sampled Yards (Known Yards)		1,001	properties					
Removal Access		1,001	properties					
Access and Property Documentation	100%	1,001	properties		1,001	properties	$75.00	$75,075
Best Effort Letters for Refusals	14%	140	letters		140	letters	$5.50	$770
Excavation & Placement of Clean Fill		1,001	properties	Even though 14% of all yards are expected to refuse access, the cost assumes 100% participation				
Yard Quadrants/Areas		2,471						
One Quad		218	properties	3,000	670,350	CF	$2.87	$1,923,905
Two Quads		242	properties	6,000	1,488,300	CF	$2.11	$3,140,313
Three Quads (yards reduced by 2011 yards)		285	properties	9,000	2,721,375	CF	$2.11	$5,742,101
Four Quads (yards reduced by 2011 yards)		221	properties	12,000	2,718,300	CF	$1.63	$4,430,629
Driveway								
With yard quads								
One Quad		18	areas	1,000	18,450	CF	$2.87	$52,952
Two Quads		16	areas	1,000	18,400	CF	$2.11	$34,604
Three Quads (yards reduced by 2011 yards)		18	areas	1,000	18,450	CF	$2.11	$38,930
Four Quads (yards reduced by 2011 yards)		25	areas	1,000	25,825	CF	$1.63	$41,769
Only		15	areas	1,000	15,375	CF	$2.87	$44,126
Garden (assumes 24 inch depth excavation)		Gardens are assumed to be located in excavated quads in properties with more than two quads removed, therefore,						
With yard quads		Only 12 to 24 inch excavation included when 3 or 4 yard quadrants are remediated						
One Quad		6	areas	625	7,500	CF	$2.87	$21,525
Two Quads		8	areas	625	10,000	CF	$2.11	$21,100
Three Quads (yards reduced by 2011 yards)		17	areas	625	10,625	CF	$2.11	$22,419
Four Quads (yards reduced by 2011 yards)		41	areas	625	25,625	CF	$1.63	$41,769
Only		4	areas	625	4	LS	$2,870.00	$11,480
Play Area								
With yard quads		Play areas are assumed to be located in excavated quads in properties with more than two quads removed						
One Quad		15	areas	150	2,306	CF	$2.87	$6,619
Two Quads		27	areas	150	4,151	CF	$2.11	$8,759
Only		5	areas	150	5	LS	$2,870.00	$14,350
Final Close-out documentation		1,001	properties		1,001	properties	$75.00	$75,075
Lawn Watering (Known Yards)		1,001		7,420,050 SF	2,315,056	gallons	$2.80 /1000 gal	$6,019
Non-Interim Action Sampled Yards (Potential)		Percent estimates based on the above known yards						
Removal Access		3,012	properties					
Access and Property Documentation	100%	3,012	properties		3,012	properties	$37.50	$112,950
Best Effort Letters for Refusals	14%	421	letters		421	letters	$5.50	$2,316
Excavation & Placement of Clean Fill		3,012	properties	Even though 14% of all yards are expected to refuse access, the cost assumes 100% participation				
Yard Quadrants/Areas		8,581	quads					
One Quad (17%)	17%	512	properties	3,000	1,574,400	CF	$2.87	$4,518,528
Two Quads (19%)	19%	572	properties	6,000	3,517,800	CF	$2.11	$7,422,558
Three Quads (25%)	26%	783	properties	9,000	7,223,175	CF	$2.11	$15,240,899
Four Quads (37%)	38%	1,144	properties	12,000	14,071,200	CF	$1.63	$22,936,056
Driveway								
With yard quads								
One Quad	8%	40	areas	1,000	41,000	CF	$2.87	$117,670
Two Quads	7%	40	areas	1,000	41,000	CF	$2.11	$86,510
Three Quads	8%	62	areas	1,000	63,550	CF	$2.11	$134,091
Four Quads	11%	125	areas	1,000	128,125	CF	$1.63	$208,844
Only	1.2%	36	areas	1,000	36,900	CF	$2.87	$105,903
Garden (assumes 24 inch depth excavation)		Gardens are assumed to be located in excavated quads in properties with more than two quads removed, therefore,						
With yard quads		*Only 12 to 24 inch excavation included when 3 or 4 yard quadrants are remediated*						
One Quad	3%	15	areas	625	18,750	CF	$2.87	$53,813
Two Quads	3%	17	areas	625	21,250	CF	$2.11	$44,838
Three Quads	5%	28	areas	625	17,500	CF	$2.11	$36,925
Four Quads	8%	45	areas	625	28,125	CF	$1.63	$45,844
Only	0.3%	9	areas	625	9	LS	$2,870.00	$25,830
Play Area								
With yard quads		Play areas are assumed to be located in excavated quads in properties with more than two quads removed						
One Quad	7%	35	areas	150	5,381	CF	$2.87	$15,444
Two Quads	11%	62	areas	150	9,533	CF	$2.11	$20,114
Only	0.4%	12	areas	150	12	LS	$2,870.00	$34,440

Table 6

Detailed Cost Estimate
Alternative 3 - Soil Removal with 24-Inch Excavation
St. Francois County Mined Areas - Residential Feasibility Study

Item/Description	Quantity		Est. per each costing unit	Costing Unit Quantity	Unit	Unit Cost	Total Cost
Final Close-out documentation	3,012	properties		3,012	properties	$75.00	$225,900
Lawn Watering (Potential Additional Yards)	3,012	properties	25,759,350 SF	8,036,917	gallons	$2.60 /1000 gal	$20,896
SUBTOTAL DIRECT CAPITAL COSTS - Known Yards							$15,754,487
SUBTOTAL DIRECT CAPITAL COSTS - Potential Additional Yards							$51,410,366
SUBTOTAL DIRECT CAPITAL COSTS - Removal							*$67,164,854*
Interim Action Sampled Yards (Known Yards)							
Mob/Demob						10%	$1,575,449
Engineering/Administration Costs						15%	$2,363,173
Construction Management Costs						15%	$2,363,173
Health & Safety						3%	$472,635
Non-Interim Action Sampled Yards (Potential)							
Mob/Demob						10%	$5,141,037
Engineering/Administration Costs						15%	$7,711,555
Construction Management Costs						15%	$7,711,555
Health & Safety						3%	$1,542,311
SUBTOTAL INDIRECT CAPITAL COSTS - Known Yards							$8,774,430
SUBTOTAL INDIRECT CAPITAL COSTS - Potential Additional Yards							$22,106,458
SUBTOTAL INDIRECT CAPITAL COSTS - Removal							*$28,880,887*
Scope and Bid Contingencies - Removal only						35%	$33,616,009
TOTAL ESTIMATED CAPITAL COST REMOVAL							**$129,661,751**
TOTAL ESTIMATED CAPITAL COST (SAMPLING AND REMOVAL)							***$130,365,403***
ANNUAL O&M COSTS							
None							
PERIODIC COSTS							
Five-Year Review							$75,156
Sampling and Analysis = resampling surface soils at remediated properties (5 years x 574 yards/yr) at a 5% rate						$20,156	
Access	144	properties	1	days	$680.00	$680.00	
Sampling	144	properties	8	days	$1,700.00	$13,600.00	
Sampling Analysis			2	days	$1,700.00	$3,400.00	
Calibration Samples to Analytical Laboratory	36	samples	36	sample	$28.00	$1,008.00	
Data Management	144	properties	8	hours	$95.00	$760.00	
Result Letter Mailing	144	properties	1	mailings	$708.14	$708.14	
Summary of Removal Action to date					1	$55,000	
Remedial Action Report					$75,000		$75,000
TOTAL ESTIMATED PERIODIC COST							***$150,156***
TOTAL NON-DISCOUNTED COST							***$130,515,559***
TOTAL PRESENT WORTH (7% rate of return, 30 year period)							***$107,618,000***

NOTES:

Cost Assumptions are provided in Appendix A

Total Present Worth calculation presented in Table A-2