

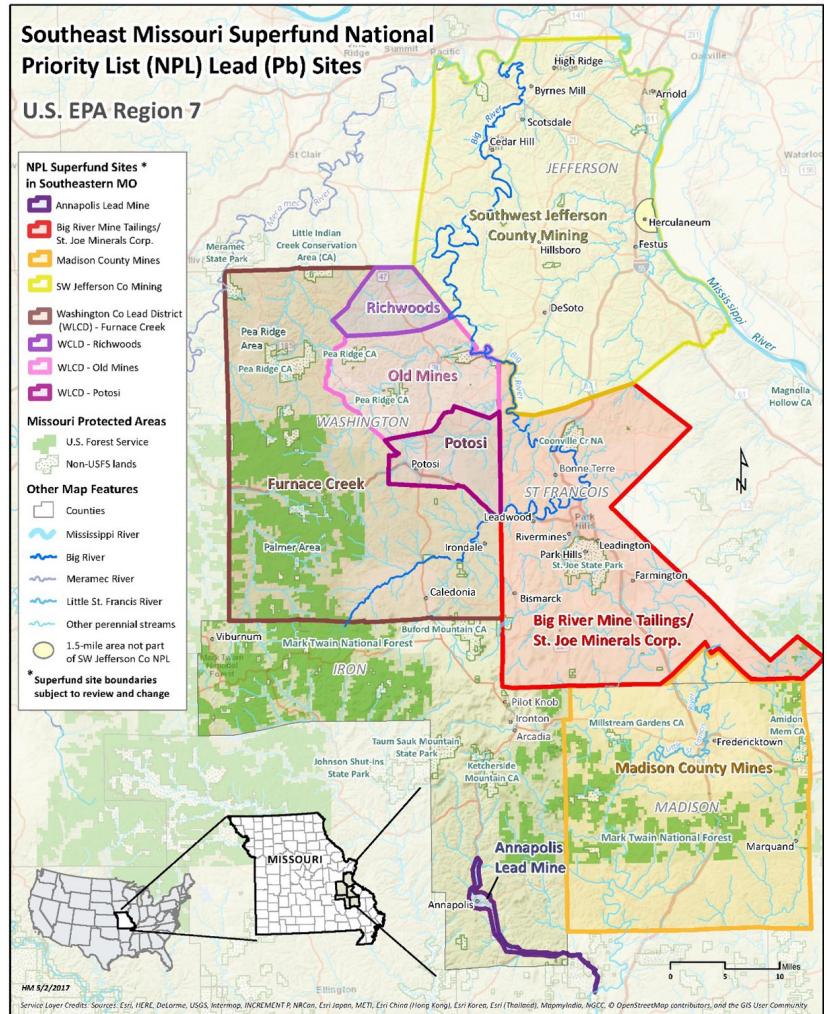
### Introduction

Missouri's Old Lead Belt was once one of the world's most productive lead mining areas, producing millions of tons of lead. Mining, milling and smelting operations left behind 250 million tons of lead-contaminated mine waste, harming the health of people and the environment. Over the past several decades, EPA has led an effort to clean up the area's mining legacy, allowing the continued safe use of thousands of properties.

This case study focuses on the cleanup of lead-contaminated residential areas at eight Superfund sites in southeast Missouri:

- Southwest Jefferson County Mining
- Washington County Lead District
  - Richwoods
  - Old Mines
  - Potosi
  - Furnace Creek
- Big River Mine Tailings/St. Joe Minerals Corp.
- Madison County Mines
- Annapolis Lead Mine

Altogether, the eight sites cover more than 2,000 square miles. They include almost all of Jefferson, Washington, St. Francois and Madison counties.



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# Mining History

The eight sites in this case study are part of Missouri's Old Lead Belt – once one of the world's largest lead mining districts. In its heyday, it provided about 80% of the lead produced in the United States. Mining began in the early 1700s. Originally, the mines were surface diggings that relied on hand labor with pick and shovel; later, underground mines started. All told, the Old Lead Belt produced more than 8.5 million tons of lead, with the most productive period stretching from 1864 to 1972.

Over centuries of mining, thousands of mining, milling and smelting sites operated at the sites. Remnants of mining activities in the area include strip mines, mineshafts, mine dumps, tailing areas, tailings ponds and dams. An estimated 250 million tons of lead-contaminated mine waste were produced in the Old Lead Belt by ore milling and beneficiation processes. The mine waste contains lead and other heavy metals that pose a threat to human health and the environment. Erosion of these deposits by wind and water resulted in contaminated soil, sediment, surface water and groundwater.

Human activities also inadvertently brought people into contact with mine waste. As the region grew over the past 200 years, homes were built on mine waste and near old tailings ponds, which were attractive to buyers seeking waterfront property. Mine waste was used as soil and fill in yards, driveways, parking areas and playgrounds. It was used as a soil amendment, as aggregate for road construction, and for snow and ice control on roads. Chat was used extensively as ballast in railroads, aggregate in concrete and asphalt, and construction fill. Because of their lime content, tailings were used as agricultural amendments. Contaminated floodplain soils were used extensively in residential areas as fill and topsoil.



*Barite (tuff) mining boomed in 1926 after the mineral's use for oil drilling mud was discovered. For a number of years, Washington County was the world's leading producer of barite. This 1937 photo shows a windlass used to raise tuff ore (photo credit: U.S. Forest Service [USFS]).*



*Tuff miner sorting ore, 1937 (photo credit: USFS).*

**Chat deposits:** sand-to-gravel-sized material resulting from the crushing, grinding and dry separation of the ore material.

**Tailings deposits:** sand- and silt-sized material resulting from the wet washing or flotation separation of ore material.

## Site Investigations

Centuries of extensive lead mining, milling and smelting in the area resulted in high levels of lead and other heavy metals in soil, sediment, surface water and groundwater. This contamination poses a risk to human health and the environment. For example, at the Madison County Mines site, sampling in the 1990s found that as many as 12% of the children living around mine waste locations had elevated levels of lead in their blood. At the Big River Mine Tailings site, 17% of children tested in the mining area had elevated levels of lead in their blood; a comparable city with similar homes had a rate of only 3%.<sup>1</sup>

EPA investigations found that about 42% of residential properties at the Madison County Mines site were contaminated. In 1977, at the Big River Mine Tailings site, heavy rains caused an estimated 50,000 cubic yards of tailings to slough into the Big River. These tailings had very high levels of lead – about 0.5% – causing fish downstream to have high lead levels.

The risks to human health and the environment prompted the need for state and EPA involvement. EPA listed the sites on the Superfund program's National Priorities List between 1992 and 2011. To determine where cleanup was needed, EPA collected over 25,000 soil samples. The map on the next page shows the sampling locations color-coded by their highest detected concentration of lead in soil. EPA also sampled over 6,000 drinking water wells and found that one in 10 exceeded the drinking water standard for lead.

“Speaking as a county commissioner, we have a very good relationship with the EPA Superfund program and we're very happy with the current cleanup contractor. When problems came up in the past, we communicated with EPA and they corrected the situation. The cleanups benefit the health of the community, and also provide good-paying jobs to local residents.”

**- Doug Short,  
Washington County Commissioner**

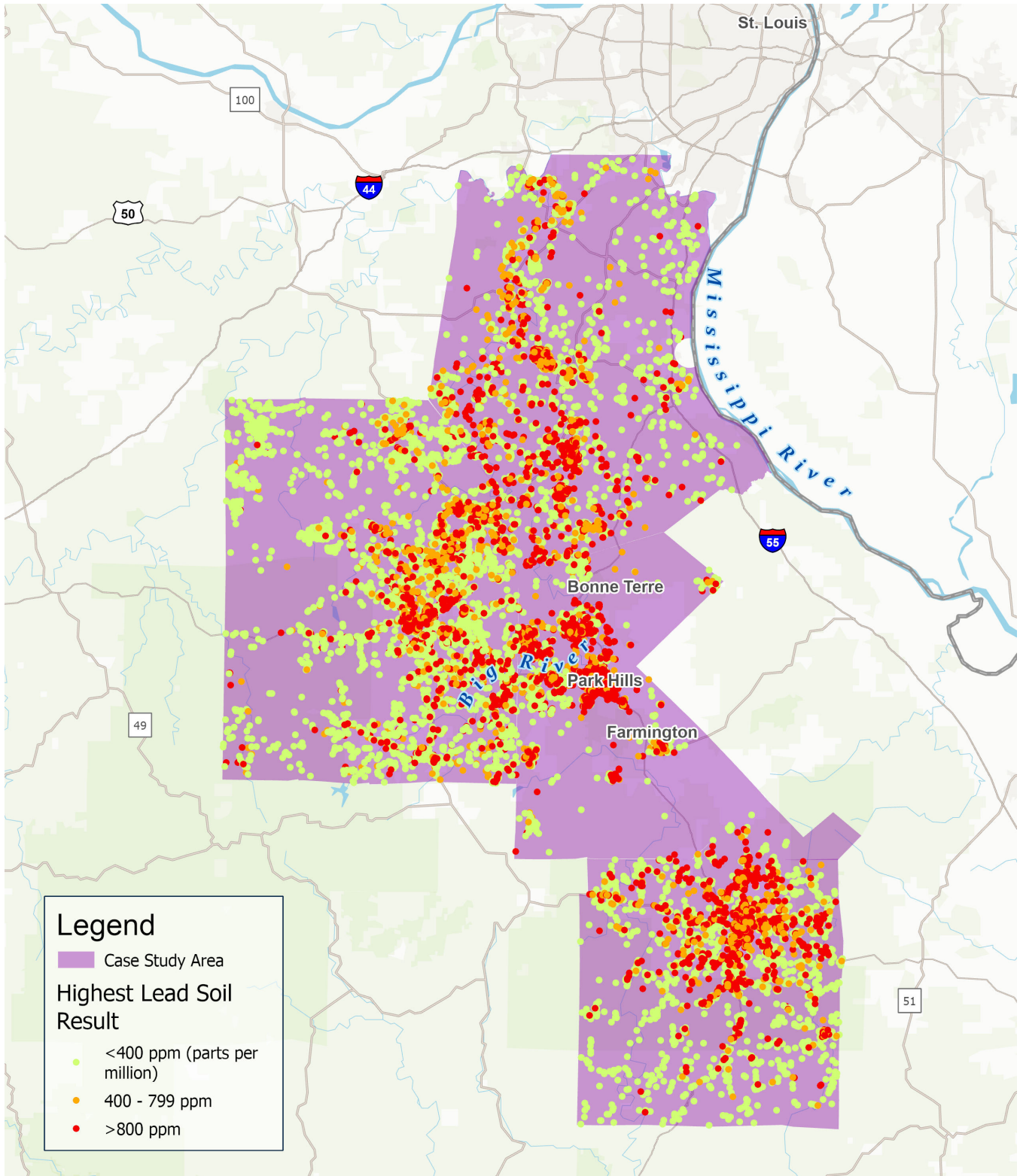
### Effects of Lead on Children's Health

Lead can damage children's developing brains and nervous systems, and causes other health problems as well. Exploration of the physical environment is a natural developmental process for young children, who often put their hands and other objects in their mouths. The concern emerges when they may inadvertently ingest lead from dust or soil on their hands or other objects. Given their higher contact rates with soil or dust, young children are most susceptible to lead exposure because they absorb lead more readily than adults and are more sensitive to the adverse effects of lead than are older children and adults. The effect of greatest concern in children is impairment of their developing brains and nervous systems, including learning deficits, reduced intelligence and adverse effects on behavior. Lead can harm a wide variety of organ systems including the nervous, cardiovascular, kidney, immune, hematological, reproductive and developmental systems. Exposure to lead is also likely to cause cancer.



<sup>1</sup> Data sources: EPA's Five-Year Review Reports for Madison County Mines (2018) and Big River Mine Tailings (2020)





**Legend**

- Case Study Area

**Highest Lead Soil Result**

- <400 ppm (parts per million)
- 400 - 799 ppm
- >800 ppm

**Soil Sampling Results at Southeast Missouri NPL Lead Sites**  
 U.S. EPA Region 7

0 5 10 20 Miles

Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Sites. Sources: Missouri DNR, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, the 2017 Fact Sheet and the WCLD Old Sites 2022 Five-Year Review.

**Skeo**  
 Last Modified: 10/21/2022

## Early Actions to Address Urgent Needs

Under the Superfund program, when a site poses an urgent threat to human health or the environment, EPA takes (or requires responsible parties to take) early actions to address these risks. These cleanups are called “removal actions.” They are executed quickly, without all of the steps required for long-term cleanups. From 1997 to 2011, early actions were taken at all eight of the sites, with the highest priority given to daycares, parks, playgrounds and homes with children with elevated blood lead levels.

EPA and the responsible parties replaced lead-contaminated soil at about 2,500 properties as removal actions. At one neighborhood in Madison County, more than half the yards had high lead levels. A time-critical removal action in 2000 cleaned up these residential properties. The removal action also addressed the tailings piles in the neighborhood by regrading the slopes, covering the tailings with 1 foot of clean soil and revegetating the soil.

Early actions also provided safe alternative drinking water to more than 300 homes, by providing either bottled water or filtration systems. At the Annapolis Lead Mine site, a family was living on the site in an area with high levels of lead contamination. EPA’s removal action program relocated the family to safe housing.



Areas in Bonne Terre (top) and Desloge (bottom) where lead-contaminated soil was removed.

### EPA's National Lead Strategy

In October 2022, EPA published its Strategy to Reduce Lead Exposures and Disparities in U.S. Communities. EPA developed the Lead Strategy to strengthen public health protections and address legacy lead contamination for communities with the greatest exposures. Engaging with communities across the country, as well as with federal, tribal, state and local government partners, was an integral part of developing the *Lead Strategy*.

The *Lead Strategy* sets out four goals:

1. Reduce community exposures to lead sources.
2. Identify communities with high lead exposures and improve their health outcomes.
3. Communicate more effectively with stakeholders.
4. Support and conduct critical research to inform efforts to reduce lead exposures and related health risks.

EPA is following three approaches to achieve these goals:

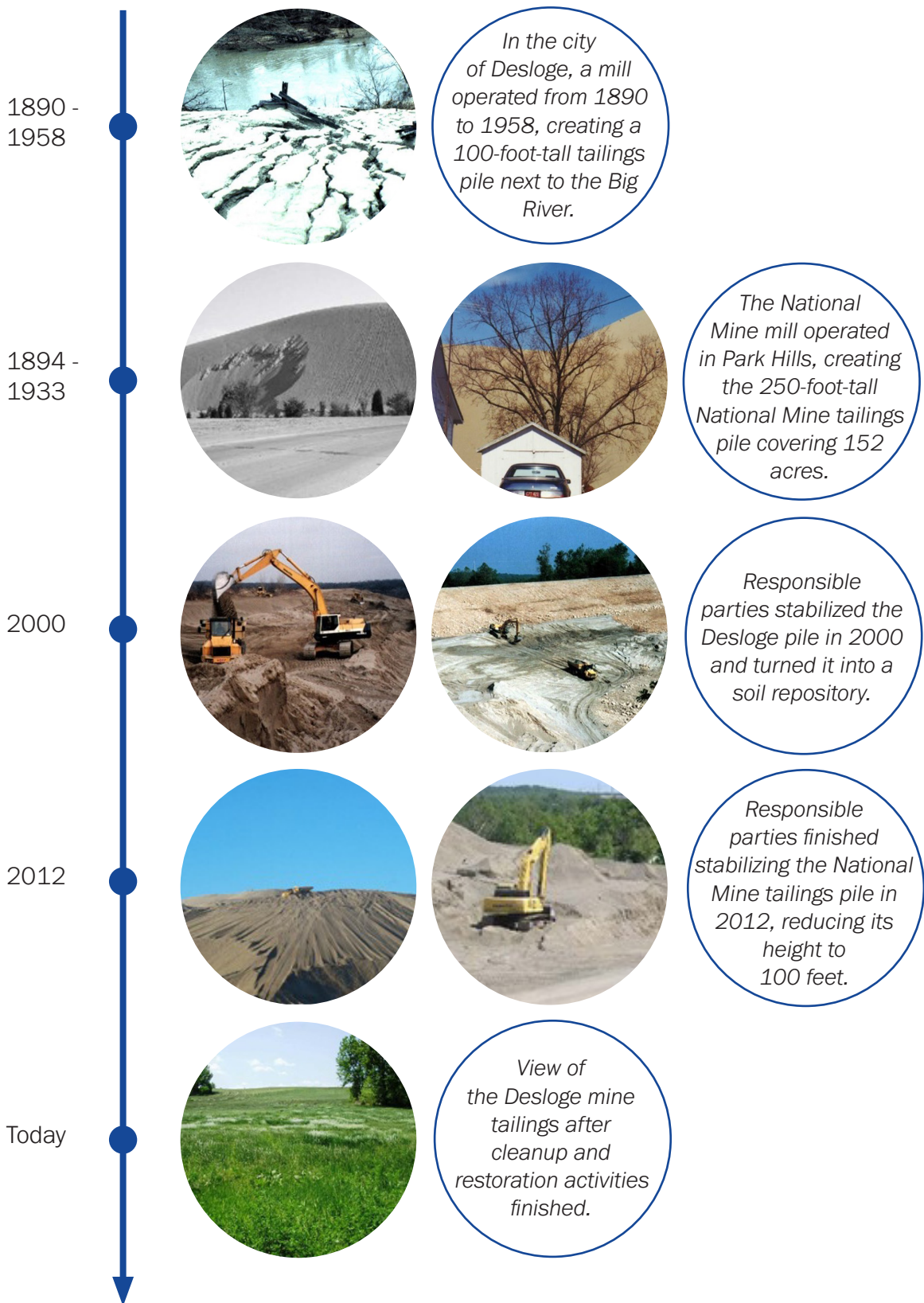
- Reduce lead exposures locally, with a focus on communities with disparities, and promote environmental justice.
- Reduce lead exposures nationally through protective standards, analytical tools and outreach.
- Reduce lead exposures with a “whole of EPA” and “whole of government” approach.

The *Lead Strategy* defines challenges to achieving each of these goals and identifies actions the Agency will take to address them. Despite great progress over the past few decades to reduce lead exposure, EPA still has important work to do, especially in communities already burdened by pollution and other stressors. Working locally, nationally and with a whole of government approach, EPA is determined to take ambitious actions that follow the science and advance justice and equity to rid communities of harmful lead exposure and the resulting toxic effects.

To learn more, please visit <https://www.epa.gov/lead/final-strategy-reduce-lead-exposures-and-disparities-us-communities>.



# Early Actions to Clean Up Tailings Piles - Two Examples



## Long-Term Cleanups

After addressing immediate cleanup needs using removal actions, EPA selected long-term cleanup plans to address residential soil and drinking water. These cleanup plans are described in the sites' Records of Decision. The cleanup plans for the eight sites are similar and include the following general components:

- Cleaning up lead-contaminated soil in residential yards and at other properties where children could be exposed, such as parks and playgrounds.
- Addressing private wells.
- Conducting health education about lead through county health departments.
- Establishing institutional controls to safeguard future residential development and protect remediated residential properties from lead recontamination.

Over 25,000 properties, including residential yards, schools, daycares, churches, parks and playgrounds, have been tested across the eight sites. More than 11,000 of the properties qualify for cleanup. So far, over 8,000 properties have been cleaned up across the four affected counties (see the map on next page). In addition, more than 300 residences have been supplied with safe drinking water. EPA leads some of the cleanup work. The mining companies responsible for the contamination do some of it as well.

EPA is working with the Missouri Department of Natural Resources, the Missouri Department of Health and Senior Services and county health departments, as well as other state and federal agencies. EPA plans to address other aspects of the sites (for example, groundwater and streams) after investigations of those areas are complete.

After cleanup of the Annapolis Lead Mine site, EPA deleted the site from the National Priorities List in September 2020. At the other sites, cleanup work is ongoing – EPA and the responsible parties continue to collect soil samples and test private wells, with yard cleanups and safe drinking water provided for all homes that qualify. For some of the sites, EPA provides vacuum cleaners to residents to help reduce lead dust in the homes.



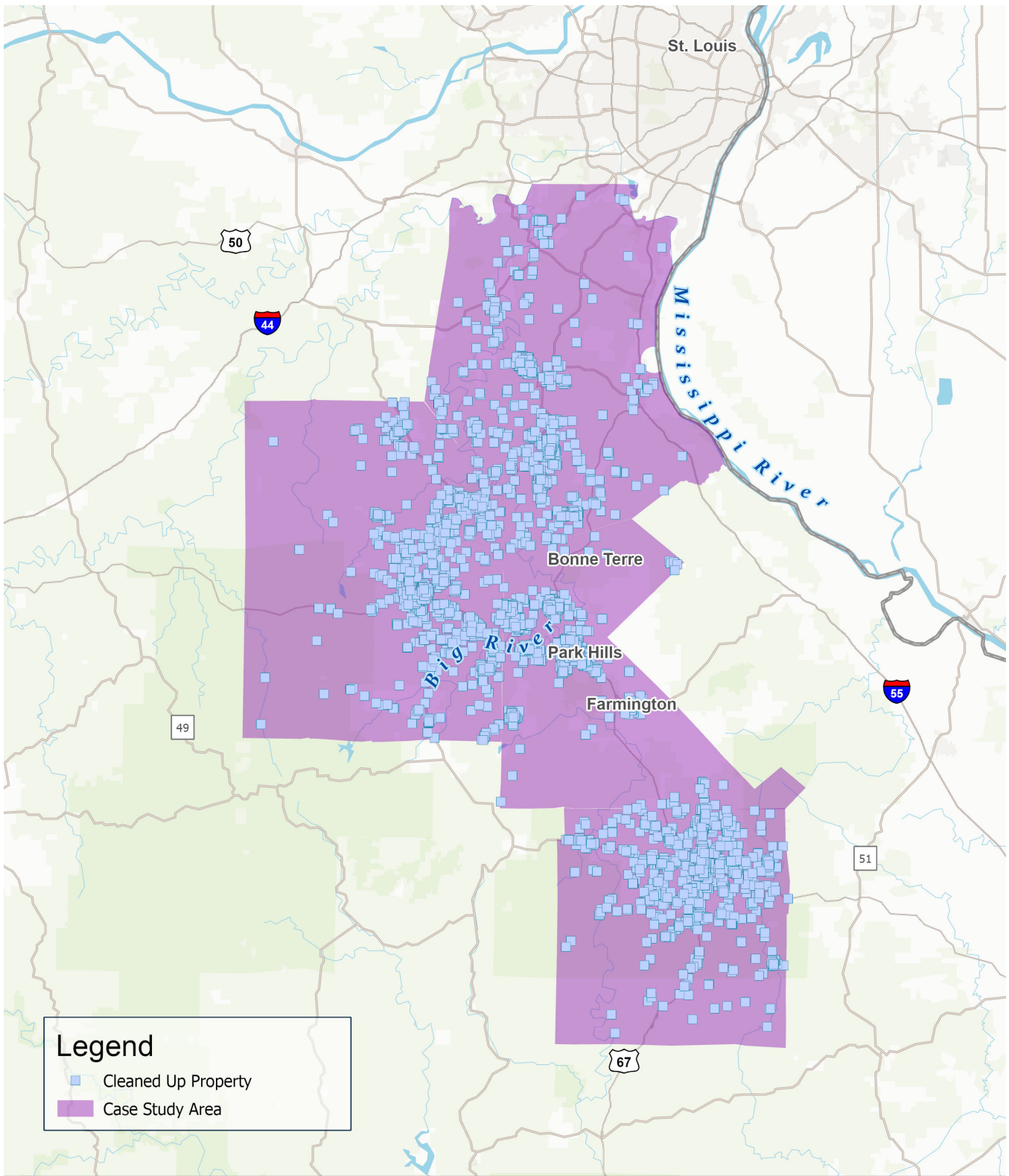
**25,000+**  
properties tested



**8,000+**  
properties cleaned up



**300+**  
residences supplied with  
safe drinking water



**Legend**

- Cleaned Up Property
- Case Study Area



**Cleaned Up Properties at Southeast Missouri NPL Lead Sites**

U.S. EPA Region 7



*Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Sites. Sources: Missouri DNR, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, the 2017 Fact Sheet and the WCLD Old Sites 2022 Five-Year Review.*



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# The Yard Cleanup Process

After receiving approval from the property owner, the cleanup contractor excavates the top 1-2 feet of contaminated soil and takes it to one of the on-site soil repositories for disposal. The yard is then backfilled with clean soil and grass is replanted.

At properties where contamination is left underneath the clean soil, a highly visible orange plastic warning barrier is placed at the base of the excavation so that anyone digging in the future will know that contamination is present. EPA is working with the county health departments to make sure that residents take proper precautions when digging in areas where contamination remains at depth.

## Providing Safe Drinking Water

EPA and county health departments have sampled over 6,000 private drinking water wells to make sure that people are not using water with unsafe levels of lead or other heavy metals. So far, EPA has provided safe water to the residents of more than 300 homes, using either water filtration systems or bottled water. EPA is evaluating how to provide a permanent source of safe drinking water to affected homes.



*Residential yard during excavation.*



*Residential yard backfilled with clean soil.*



*Residential yard after restoration.*



*Residential yard cleanups underway at the Big River Mine Tailings/St. Joe Minerals site.*



*Middle school cleanup taking place at the Big River Mine Tailings/St. Joe Minerals site.*

“The Missouri Department of Natural Resources collaborates closely with the EPA and other government partners to support reducing harmful exposure to lead in our residential communities and in protecting our natural resources for the benefit of Missourians. The Department of Natural Resources maintains records on historical lead and other metal mining occurrences and prospects in the state, participates in investigations and cleanup actions, and interacts with Missouri residents. The Department is pleased to be an active part of improving the health and environment of the state.”

**- Chinwe Ndubuka, Missouri Department of Natural Resources, Environmental Remediation Program**

## Raising Public Awareness

Raising public awareness about the importance of avoiding lead exposure is an important part of EPA's cleanup plan for the sites. EPA is collaborating with the state and county health departments to provide health education and exposure prevention information to community members. A variety of communication methods are used, from face-to-face education of families in health clinics to newspaper articles, radio spots and billboards.

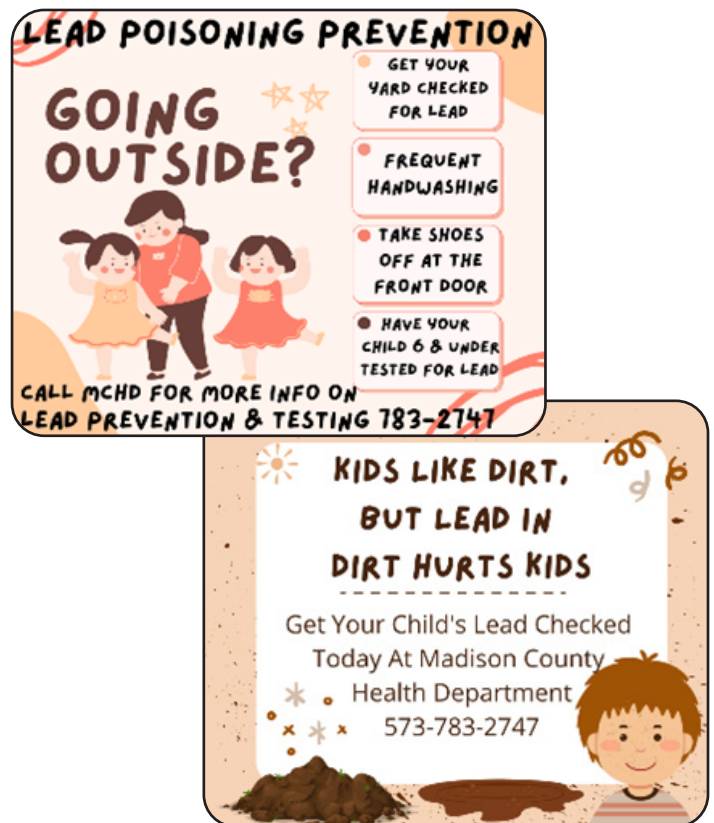
The county health departments are managing Voluntary Institutional Control Programs to raise public awareness about the presence of lead and its impact on human health and the environment. The goal of the programs is to keep track of where digging is planned so that the health department can provide sampling, training and assistance to residents, public utilities and contractors to ensure proper handling and disposal of contaminated soil. For example, the Madison County Health Department monitors the One Call notifications that are submitted prior to digging, so that staff members can educate people who are planning to dig in areas where contaminated soil may be present. When contaminated soil is excavated, people can safely dispose of it at EPA's soil disposal repositories. The Madison County Health Department also offers free lead testing for children and free residential yard testing.

"Region 7 EPA has worked diligently over the past three decades remediating lead-contaminated properties in the Old Lead Belt by our Removal and Remedial Programs with contributing efforts by the potentially responsible parties. This work has reduced lead exposure to thousands of residents, particularly children who may be most impacted, and has resulted in close partnerships with the state of Missouri and local health departments to continue this important work into the future."

- Daniel Kellerman, EPA project manager

## Scientific Understanding of the Health Effects of Lead Continues to Evolve

Until recently, children were identified as having a blood lead level of concern if the test result is 10 or more micrograms per deciliter of lead in blood. Experts now use a new level based on the U.S. population of children ages 1-5 years who are in the top 2.5% of children when tested for lead in their blood (when compared to children who are exposed to more lead than most children). Currently, that is 5 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) of lead in blood. The new, lower value means that more children likely will be identified as having lead exposure allowing parents, doctors, public health officials and communities to take action earlier to reduce the children's future exposure to lead. As part of EPA's collaboration with county health departments, the departments provide lead testing to local families to identify children with elevated blood lead levels.

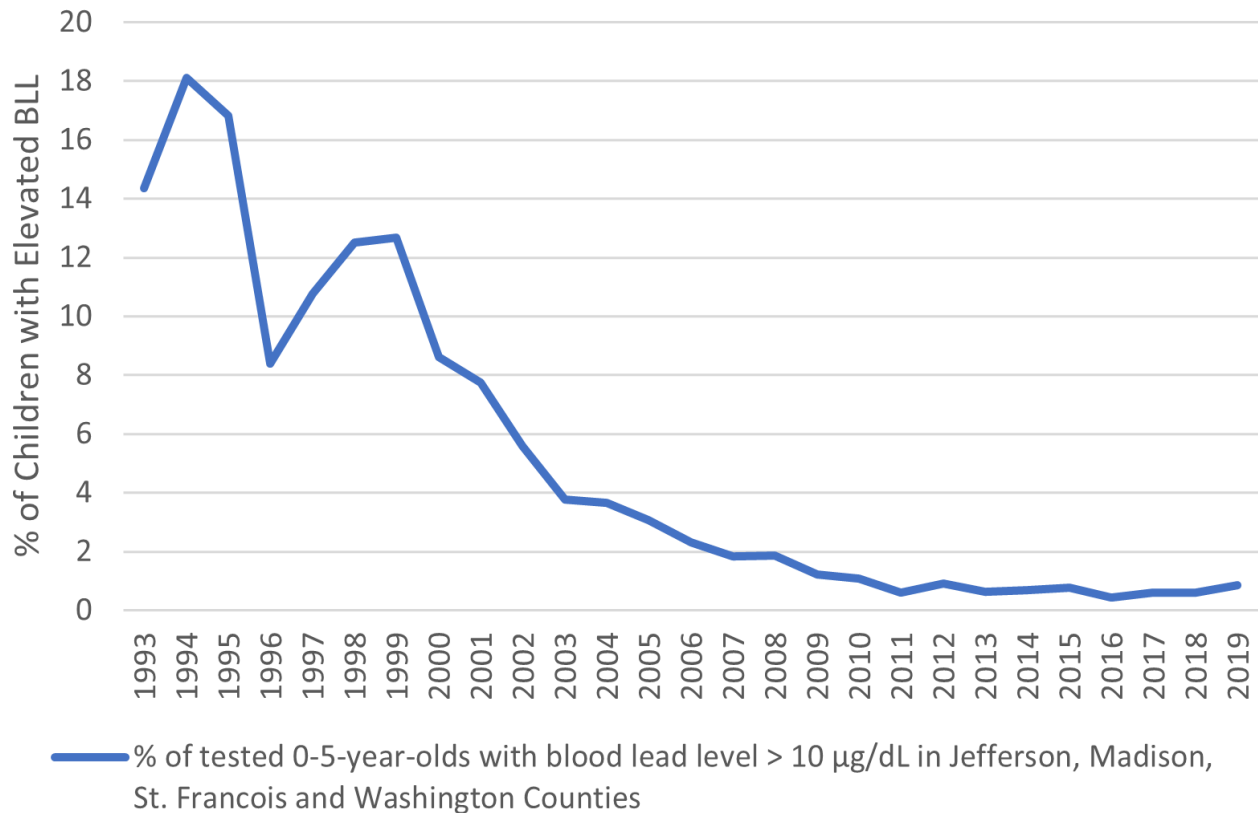


County health departments use a variety of approaches to inform the public about ways to reduce exposure to lead contamination.



## Reducing Lead Levels in Children: A Public Health Victory

EPA's response actions have resulted in a significant reduction of blood lead levels in children. As shown in the chart below, the percentage of children with elevated blood lead levels has dropped from levels as high as 18% in the 1990s to below 1% in recent years.<sup>2</sup> In Madison County, the percentage dropped from around 12% in 1998 to less than 2% today.<sup>3</sup>



“I was born and raised in Madison County and lived in one of the original mining areas. Generations ago, my family supported itself through mining. Now, as a public health professional, I have the privilege of leading the Madison County Health Department. With support from EPA, we take an active role in educating our community about the impact lead poisoning has on our children and the importance of incorporating prevention measures to reduce and eliminate lead in our children’s daily lives and play. These prevention efforts, together with EPA’s residential soil cleanups, have been tremendously successful, reducing the percentage of children with elevated blood levels from 12% to less than 2% over 10 years.”

**- Becky Hunt, Administrator, Madison County Health Department**

<sup>2</sup>. Data sources: Missouri Environmental Public Health Tracking (2000-2019 data) and personal communication with Missouri Department of Health and Senior Services (1993-1999 data)

<sup>3</sup>. Data source: EPA’s Five-Year Review Report for Madison County Mines (2018)

# Protecting and Restoring Recreation Opportunities

## Restoring the Big River for Fishing and Recreation

In addition to the residential cleanups that are the focus of this case study, EPA is also addressing the ecological concerns posed by the sites. For example, in 2015, EPA completed a time-critical removal action to stabilize the Rockford Beach Dam in Jefferson County. This action prevented the failure of the dam and the release of lead-contaminated sediments farther downstream on the Big River.

The Big River is used for recreational purposes such as fishing and canoeing, as well as for commercial activities such as watering livestock. Currently, the state of Missouri advises people not to eat fish they catch from the Big River downstream of the contaminated area. To protect human health, EPA posts health and fish advisory signs along access points to the Big River where elevated levels of lead in the sediment have been detected. In time, EPA expects that the Superfund cleanups will help restore the Big River for all uses.

## S-F Scout Ranch

EPA removed lead contamination from the S-F Scout Ranch in 2020 and 2021, completing the cleanup in time for the camp to open for the 2021 summer season. The cleanup areas included campsites, areas around various scout buildings, council rings and two road sections used as hiking trails. Nearly 8,000 cubic yards of soil and rock, spread across 5.1 acres, were removed and replaced with clean soil or rock.



Cleanup at the S-F Scout Ranch.

## St. Joe State Park

At St. Joe State Park, the Federal Mine mill operated from 1902 to 1970. It created a tailings pile 310 feet tall. Responsible parties stabilized the site in 2015, cleaning up 1,240 acres, resulting in a cleaned-up beach area and ATV riding area.



St. Joe State Park beach before cleanup.



During cleanup.



After cleanup.



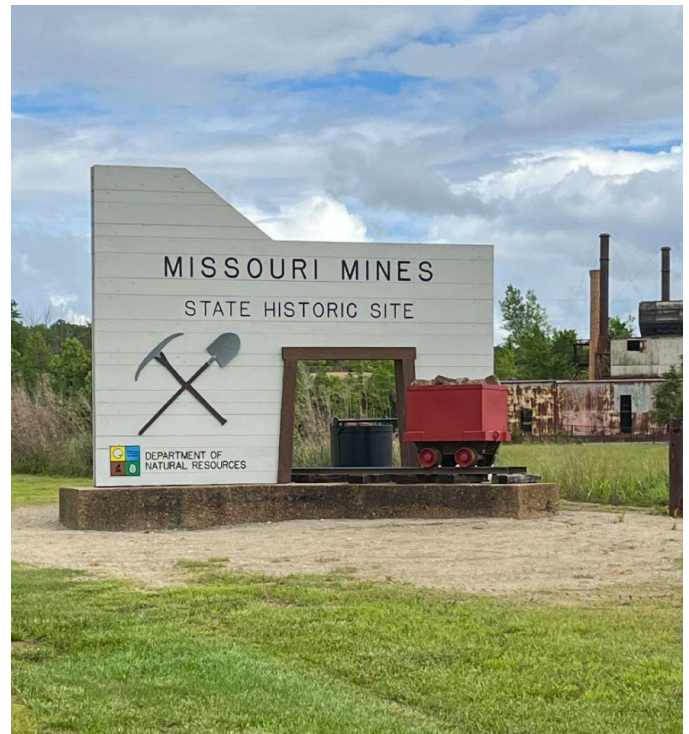
ATV riding area on the Federal Pile at St. Joe State Park.



EPA prioritizes the cleanup of playgrounds and other areas frequented by children.



Through partnerships with state and local agencies, and with the cooperation of the potentially responsible parties, EPA is making tremendous gains in cleaning up the contamination left behind by the lead mining history of Southeast Missouri's Old Lead Belt. The scope of this cleanup effort has been massive – covering more than 2,000 square miles across four counties and eight Superfund sites. Using a combination of early actions and long-term cleanups, EPA has cleaned up over 7,000 properties, including yards, schools, parks and playgrounds. In addition, more than 300 homes have been supplied with safe drinking water. Throughout the cleanup process, EPA has prioritized the cleanup of homes and properties where children may be at risk from contamination. The ongoing cleanup effort is paying off – the percentage of children with elevated levels of lead in their blood has dropped sharply since the cleanups began. Looking to the future, EPA will continue its work to address the legacy of centuries of mining in the region, with the goal of protecting the health of the area's residents as well as the environment.



*The Missouri Mines State Historic Site is on a cleaned-up parcel in Park Hills that was once part of the Federal Mine tailings pile. The St. Joe Lead Co. powerhouse is now a museum that teaches visitors about the area's lead mining history.*

“The Missouri Department of Health and Senior Services has worked closely with EPA throughout EPA’s work in the Old Lead Belt. Through EPA and others’ work there have been large reductions in the number of children with elevated blood lead levels. In 2004 in Jefferson, Washington, St. Francois and Madison counties, there were 998 children under the age of 6 tested with blood lead levels greater than 5 µg/dL. In 2021, the number of children under the age of 6 tested with blood lead levels greater than 5 µg/dL was down to 48. No child should be impacted by lead and 48 children is above the state rate and CDC’s most recent reference value for lead has decreased to 3.5 µg/dL, so we know there is still a lot of work ahead of us. But at times, it is good to reflect on the amount of work that has been done to date.”

**- Jeff Wenzel, Chief of Bureau of Environmental Epidemiology,  
Missouri Department of Health and Senior Services**