FIFTH FIVE-YEAR REVIEW REPORT FOR CHEROKEE COUNTY SUPERFUND SITE CHEROKEE COUNTY, KANSAS

Prepared by

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9/15/15

Date

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LIST OF ACRONYMS

AOC	Administrative Order of Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
EUC	Environmental Use Control
FYR	Five-Year Review
HHRA	Human Health Risk Assessment
ICs	Institutional Controls
IEUBK	Integrated Exposure Uptake Biokinetic Model
KDHE	Kansas Department of Health and Environment
MCLs	Maximum Contaminant Levels
NCP	National Contingency Plan
NPL	National Priorities List
O&F	Operational and Functional
O&M	Operation and Maintenance
OU	Operable Unit
PHA	Preliminary Health Assessment
ppm	parts per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objectives
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
TBCs	To Be Considereds
TI	Technical Impracticability
TSMD	Tri-State Mining District
µg/dL	micrograms per deciliter

EXECUTIVE SUMMARY

This is the fifth Five-Year Review (FYR) for the Cherokee County Superfund site (Site) located in Cherokee County, Kansas. The purpose of this FYR is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory review is the completion date of the previous FYR on September 30, 2010.

The first FYR was completed in September 1995 and exclusively addressed Operable Unit (OU) 01, Galena Alternate Water Supply. The second, third and fourth FYRs were completed in September 2000, 2005, and 2010, respectively, and they encompassed all remedial actions (RAs) conducted to date in OUs 01 through 07.

The Site is located in southeast Kansas and is 115 square miles in size. The Site is divided into seven subsites that are grouped and divided into nine operable units. Lead and zinc mining was conducted for over 100 years from the middle 1800s to 1970 at the Site, and the primary contaminants of concern are lead, zinc, and cadmium. Millions of cubic yards of mine tailings are present at the surface in addition to impacted soils, surface water, sediments and groundwater. The Site was listed on the National Priorities List (NPL) in September 1983. Several Records of Decision (RODs) have been issued and many cleanups have been completed or are currently underway. Several Consent Decrees (CDs) with responsible parties have also been completed and responsible parties have funded and conducted many cleanups at the Site in addition to cleanup actions funded and implemented by the U.S. Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE). Bankruptcy settlements have also yielded monies for Site use in addition to American Recovery and Reinvestment Act funding. Site-wide, nearly three million cubic yards of mining wastes have been remediated on nearly 2,000 acres, over 700 residential yards have been remediated, and over 500 homes have been supplied with a clean, permanent source of drinking water. An EPA field office has been established at the Site to better oversee the many engineering designs, site characterizations, and RAs that are underway in addition to monitoring, operation and maintenance (O&M) activities for the many completed remedies.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Cherokee County		
EPA ID: KSD980741862		
Region: 7	**State:** KS	**City/County:** Cherokee County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): Elizabeth Hagenmaier
Author affiliation: U.S. EPA Region 7
Review period: 8/1/2014 – 8/31/2015
Date of site inspection: 7/22/2015
Type of review: Statutory
Review number: 5
Triggering action date: 9/30/2010
Due date *(five years after triggering action date)*: 9/30/2015

Five-Year Review Summary Form (continued)

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
01, 03, 04, 06, 07

Issues and Recommendations Identified in the Five-Year Review:

OU(s): *05*	**Issue Category: Operations and Maintenance**			
	Issue: Assess vegetation and engineering enhancements at portions of the completed OU 05 remedy.			
	Recommendation: Continue assessing various amendments for use in optimally establishing vegetation and assessing engineering enhancements for portions of the completed OU 05 remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2020

Protectiveness Statement(s)

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
01	Protective	N/A
Protectiveness Statement: The remedy at OU 01 is protective of human health and the environment.		

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
03	Will be Protective	N/A
Protectiveness Statement: The remedy at OU 03 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks have been addressed.		

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
04	Will be Protective	N/A

Protectiveness Statement:
The remedy at OU 04 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
05	Short-term Protective	N/A

Protectiveness Statement:
The OU 05 remedy currently protects human health and the environment because highly contaminated soils have been excavated from residential and nonresidential properties. However, in order to be protective in the long term, O&M enhancements to 200 acres of steep terrain and/or areas with low nutrient soils need to be implemented to reduce O&M costs and promote vegetation growth.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
06	Protective	N/A

Protectiveness Statement:
The remedy at OU 06 is protective of human health and the environment.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
07	Protective	N/A

Protectiveness Statement:
The remedy at OU 07 is protective of human health and the environment.

I. INTRODUCTION

The purpose of a FYR is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The EPA prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 121 and the National Contingency Plan (NCP). CERCLA 121 states:

> "*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."*

The EPA interpreted this requirement further in the NCP, 40 Code of Federal Regulations (CFR) section 300.430(f)(4)(ii), which states:

> "*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action*."

The EPA conducted a FYR on the remedies implemented at the Cherokee County Superfund Site in Cherokee County, Kansas. The EPA is the lead agency for developing and implementing the remedies for the Site. KDHE, as the support agency representing the State of Kansas, has reviewed all supporting documentation and provided input to the EPA during the FYR process.

This is the fifth FYR for the Cherokee County Superfund Site. The triggering action for this statutory review is the completion date of the previous FYR. The FYR is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. The Site consists of nine OUs. The status of these OUs is summarized in the table below:

Table 1: Status of OUs

Operable Unit	Status
01 – Galena Alternate Water Supply	Operation and Maintenance
02 – Spring River Basin	Remedial Investigation
03 – Baxter Springs	Under Construction
04 – Treece	Under Construction
05 – Galena Groundwater/Surface Water	Operation and Maintenance
06 – Badger, Lawton, Waco, and Crestline	Operation and Maintenance
07 – Galena Residential Soils	Operation and Maintenance
08 – Railroads	Remedial Investigation
09 – Tar Creek Watershed	Remedial Investigation

This FYR evaluates the remedies implemented at OU 01, OU 03, OU 04, OU 05, OU 06, and OU 07.

II. SITE CHRONOLOGY

A chronology of significant Site events and dates is included in Appendix A.

III. BACKGROUND

Physical Characteristics

The Site represents the Kansas portion of the Tri-State Mining District (TSMD) and is shown on Figure 1. The TSMD encompasses approximately 2,500 square miles in Oklahoma, Kansas, and Missouri and was formerly one of the richest lead- and zinc ore-producing deposits in the world. The Kansas portion of the TSMD lies within the extreme southeast corner of the state. Because of the large geographic area of mining in Kansas, the 115-square mile site has been divided into the following seven subsites: Galena, Baxter Springs, Treece, Badger, Lawton, Waco, and Crestline. These seven subsites encompass most of the area where mining occurred within the Site and where physical surface disturbances were evident.

The TSMD is characterized by a variety of mine waste features that include the following: large piles of sand- and gravel-sized mill tailings locally known as chat; piles of overburden bedrock materials locally known as bullrock; tailings impoundments and ponds that contain accumulations of silt- and clay-sized flotation tailings; open and collapsed mine shafts, sometimes filled with water; and subsidence features. The mine waste areas contain sparse to no vegetation. Local stream systems also contain mining wastes and mining-impacted sediments and surface water. Residential areas are adjacent to mine waste accumulations in some areas or have suffered historic impacts as a result of smelting. Lead and zinc are found in mining wastes and soils at maximum concentrations of several thousand parts per million (ppm), while cadmium is typically found at levels less than 500 ppm. The TSMD and associated watersheds are shown on Figure 2.

Hydrology

The subsites are underlain by two aquifers that are separated by a confining unit. The shallow aquifer is comprised of Mississippian limestones which host the lead-zinc deposits that were mined at the subsites. Water quality in the shallow aquifer is generally poor, with some water samples exceeding Maximum Contaminant Levels (MCLs) for arsenic, cadmium, lead, mercury and nickel. Groundwater from the lower levels of the mine pools tends to be acidic. The shallow aquifer is not used at the subsites for domestic or stock water supplies. Other than movement downgradient, shallow aquifer groundwater seeps from limestone outcrops to the downstream portions of Willow Creek and Spring River. The deep aquifer occurs in the Lower Ordovician Roubidoux Formation and provides the principal source of water for public, industrial, domestic and stock supplies at the subsites and surrounding areas.

Land and Resource Use

The current and anticipated future land use is predominantly agricultural with interspersed residential and light industry in population centers within the Site. Groundwater is currently not used as a drinking water source from the upper impacted aquifer. A lower isolated aquifer is used for potable water throughout the former District and this situation is expected to remain in the future.

Human exposure pathways include contact with or ingestion of metals-impacted groundwater, surface water, sediments, soils, or mining wastes. Young children, less than 84 months of age, are particularly susceptible to lead uptake, primarily through the impacted soil (and dust) exposure route. Ecological receptors are also exposed through contact or ingestion of heavy metals-impacted media.

History of Contamination

Lead and zinc mining began in the middle 1800s and continued for over a century in the TSMD; the final mining activities ceased in 1970. Sphalerite (zinc sulfide) and galena (lead sulfide) were the principle mined ores, and several other metal sulfides were found in association with the economic ores. The mining activities changed the hydrology of the area by creating a labyrinth of underground voids and many open conduits. These features facilitate surface subsidence and collapse as well as enhanced flow of mineralized groundwater in the subsurface. Surficial mining wastes also leach metals into the groundwater system and surface water bodies. The normal surface and subsurface flow characteristics have been modified by past mining activities; and since much of the surface vegetation is impacted or absent, there is increased infiltration of surface water into the shallow groundwater system and erosion of mining wastes into surface water bodies. During the active mining years, water was continually pumped out of the mines because the ore was predominantly located in the saturated zone of the same bedrock formations that contain the area's shallow aquifer. When mining ceased, the mines refilled with water as a result of natural groundwater recharge and surface water inflow through mine shafts and subsidence areas. The upper aquifer is now contaminated with metals and is acidic in some areas. Acid mine drainage is prevalent throughout many areas of the District.

The primary sources of contamination at the Site are the residual and metal sulfides in the abandoned mine workings, chat piles, and tailings impoundments in addition to historic impacts from smelting operations. Upon exposure to the atmosphere, metal sulfides can become oxidized and mobilize as dissolved compounds which increase the acidity of surface water and groundwater. The resulting metal-laden acidic water, referred to as acid mine drainage, can further leach metals from bedrock, contaminate groundwater, and fill mine shafts and subsidence features. The acid mine drainage can also surface through springs and combine with metal-laden surface water runoff to ultimately contaminate rivers, creeks, and lakes. The shallow aquifer is impacted by heavy metals as a result of past mining practices.

Initial Response

The EPA placed the Site on the NPL by publication in the Federal Register on September 8, 1983, 48 Fed. Reg. 40658. The EPA began its investigation of the Galena subsite in 1985. A Phase I remedial investigation (RI) was completed in 1986. This investigation examined the impacts of the mining activities on the groundwater, surface water, ambient air, soils, stream sediments, and fish. As a result of this work, the EPA determined additional information on the groundwater and surface water was necessary in order to evaluate potential RA. These additional investigations were conducted in 1986 and 1987.

The Galena subsite investigations demonstrated that the shallow groundwater aquifer and the surface water were contaminated with elevated concentrations of metals. Many private shallow aquifer wells were found to be contaminated with metals that exceeded the primary and secondary MCLs established by the Safe Drinking Water Act.

Initial response actions included the provision of bottled water and water softener units as removal actions prior to the construction of a permanent alternate water supply system as the final RA. This initial removal action work was conducted at OU 01. Another removal action was conducted at OU 07 and involved the remediation of residential yards that were significantly impacted by elevated levels of lead. The work was followed by a long-term RA at OU 07. These are the only two RAs conducted at the Site.

Basis for Taking Action

In 1989, the Agency for Toxic Substances and Disease Registry (ATSDR) completed a Preliminary Health Assessment (PHA) for the Galena subsite. The study indicated that "lead and cadmium in surface soil, surface water, and groundwater, are found at levels that are of public health concern." Children were identified as the main sensitive subpopulation of concern because of their potential exposure to contaminated soil and surface water. ATSDR concluded that the Site was a public health concern because of the risk to human health caused by the probable human exposure to hazardous substances at concentrations that may result in adverse health effects.

A baseline human health risk assessment (HHRA) was conducted by a group of potentially responsible parties (PRPs) in 1991 for OUs 03/04 under an Administrative Order of Consent (AOC), Docket Number VII-90-F-0010, dated May 8, 1990. Potential health effects from exposure to lead were evaluated using the EPA's Integrated Uptake Biokinetic (IEUBK) Model. The results predicted by the IEUBK model indicate that the concentrations of lead currently present in soils at these subsites present an unacceptable risk to the children living in residences located on or near mine wastes. The concentration of lead in residential soils is the main concern for the uptake of lead and projected elevated blood lead levels under both current and future residential land use scenarios.

Overall, for all OUs at the Site, the HHRA concluded that, in general, lead is the only demonstrated human health risk at the Site. However, cadmium has the potential to create an unacceptable risk resulting from the ingestion of vegetables or groundwater. Vegetables have been demonstrated to readily uptake cadmium and thus pose a potential health threat. Many studies at the other OUs at the Site have conclusively demonstrated human health risks.

In addition, an Ecological Risk Assessment (ERA) was conducted for OUs 03/04. The ERA indicated that there was a significant and unacceptable risk to aquatic organisms present at these subsites. The risk to terrestrial organisms that eat fish is also considered to be unacceptable. Additionally, a number of assumptions in the ERA result in an underestimated level of risk. Considering that the conservative ERA characterization yielded a determination of significant and unacceptable risk, this only serves to foster and emphasize the need for RA to be implemented.

IV. REMEDIAL ACTIONS

Remedy Selection

The following information summarizes the current status and completed RAs for each OU addressed in this FYR. Appendix B provides details of the selected remedies and RAOs for each ROD released for the Site.

OU 01, Galena Alternate Water Supply

OU 01 is part of the Galena subsite. The alterative water supply ROD was issued in December 1987 and included the following components: two rural water wells constructed to approximately 1,500 feet below the surface; approximately 60 miles of pipeline placed to serve nearly 500 households; construction of a water district building and fenced work area.

OU 03, Baxter Springs subsite and OU 04, Treece subsite

The EPA, through its enforcement authorities, negotiated an AOC with certain potentially responsible parties (PRPs) to conduct the remedial investigation/feasibility study (RI/FS) for both Baxter Springs and Treece subsites, OUs 03 and 04. The PRPs performing these activities under the AOC were Cyprus Amax Minerals Corporation (corporate successor is currently Freeport-McMoRan); ASARCO, Inc.; Gold Fields American Corporation; Blue Tee Corporation; NL Industries, Inc.; St. Joe Minerals Corporation (corporate successor is currently The Doe Run Co.); and Sun Company, Inc.

The EPA published its selected remedy, a mixture of residential soil remediation and source reduction, for the Baxter Springs and Treece subsites in a ROD in August 1997.

The major components of the selected remedy, which are specific to only the Baxter Springs subsite, included the following:

- excavation, relocation, regrading, capping, and revegetation of mine/mill waste piles, tailings impoundments, and tailings outwash deposits;
- stream re-channelization and construction of stream diversion/control structures; and
- prevention of mine water discharges.

The major remedy components for both the Baxter Springs and Treece subsites include the following:

- investigation and potential remediation of residential yards impacted by mining/milling wastes;
- closure/abandonment of poorly constructed existing deep water wells and borings to protect the deep aquifer;
- institutional controls for future development; and

- operation and maintenance of all remedy aspects which include, but are not limited to, the following: capped areas; stream diversion/control structures; institutional controls; and long-term monitoring.

The 1997 ROD also included a Technical Impracticability (TI) waiver for all surface water and groundwater at the Site.

The OU 03/OU 04 remedy was modified in September 2006 and included the following remedy components:

- excavate, consolidate, and/or cap all surficial mine waste followed by disposal and capping;
- utilize subaqueous mine waste disposal to the maximum extent practicable;
- encourage source reduction via responsible chat sales before and during remedy implementation; and
- adopt institutional controls for future development specified in an earlier ROD.

In addition to the amended remedy, the 2006 ROD Amendment retracted the TI waiver for surface water. The goal of the remedy is now to meet chemical-specific ARARs for surface water throughout all OUs.

A CD for the planned RD and RA for both subsites was formalized in 1999 with the same PRPs who conducted the RI/FS.

OU 05, Galena Groundwater/Surface Water

The groundwater/surface water ROD was issued in September 1989. The selected RA was to reduce the human exposure to the contaminants in the surface mine wastes, reduce the metals contamination in the groundwater and surface water, and be protective of the Roubidoux aquifer.

Nonresidential remedy components were the same as described above for OU 03 with the exception of the PRP smelter work. There is no residential component for this remedy.

PRP smelter remedy components include:

- decontaminate former smelter buildings and remove hazards (e.g., underground tanks, transformers, chemicals);
- excavate, grade, and consolidate wastes surrounding the smelter followed by capping and revegetating; and
- excavate impacted sediments from the stream near the smelter.

OU 06, Badger, Lawton, Waco, and Crestline Subsites

This OU consists of four distinct geographic subsites with PRP involvement at the Waco and Crestline subsites, exclusive EPA fund-lead activities at the Badger and Lawton subsites, and joint EPA/PRP work at the Waco subsite.

The historic RI/FS was conducted by the PRPs under an AOC issued in 1998. The RI/FS was completed in 2004 under the AOC, and a ROD was issued in 2004.

The remedy selected the following components:

- excavate, consolidate, and/or cap all surficial mining wastes and excavate metals-impacted sediments from subsite streams followed by disposal and capping;
- utilize subaqueous mine waste disposal to the maximum extent practicable, with the exception of RAs at the Badger subsite. For the Badger subsite, excavate mining wastes and dispose of materials in conventional repositories located beyond the limits of the 100-year flood plain of the Spring River;
- abandon deep wells to prevent cross-contamination between the shallow and deep aquifers;
- characterize and monitor the groundwater flow system for assessment of the subaqueous mine waste disposal components of the remedy; and
- adopt institutional controls for future development as specified in an earlier ROD.

OU 07, Galena Residential Soils

The OU7 ROD was signed in July 1996. The remedy included:

- excavation and disposal of residential soils impacted by mining wastes;
- health education for the general community and medical professionals;
- institutional controls to guide future development in residential areas impacted by mining wastes;
- treatability studies to evaluate the effectiveness of phosphate stabilization as a future alternative; and
- operation and maintenance of all remedy aspects including, but not limited to, health education, institutional controls, and long-term monitoring.

Remedy Implementation

OU 01, Galena Alternate Water Supply

This OU has been in the O&M phase since 1995.

All work was completed as a fund-lead effort, and the remedy is in place under long-term O&M by the state of Kansas. A rural water district was formed; water supply wells were installed; support buildings constructed; and the new source of drinking water was provided to 400 residences in rural areas near the community of Galena, Kansas. Nearly 1,500 people were provided with a permanent source of clean drinking water and over 57 miles of pipeline were placed during the construction effort. The upper aquifer in this area is impacted by metals contaminants (lead, zinc, and cadmium) from historic mining operations. Private, shallow water supply wells were affected and have been addressed. The municipal wells for the city of Galena are constructed in a lower pristine, potable aquifer and are not impacted by past mining

activities. The source of water for the rural water district is also the lower potable aquifer. The rural water district has expanded by over 100 new users (>500 residential hookups) since completion of the RA in 1994.

OU 03, Baxter Springs subsite

Many phases of work have been completed, are underway, and have or are being conducted by PRPs and the EPA at this subsite. The PRP portions of this OU are currently in the cleanup and O&M phases. Response actions at this OU were conducted by PRPs under a CD signed in 1999, and include residential and surficial mine waste components that were completed and are now in O&M. Approximately 1.5 million cubic yards of mining wastes have been remediated by the EPA and PRPs to date.

The residential aspect of the initial PRP response action included sampling and remediation as necessary of residential soils from properties impacted by mining activities. Mining-related activities in the Baxter Springs area consist of the importation of mining wastes from nearby waste accumulations (e.g. landscaping, fill material, driveway material) as well as erosion of wastes from these areas. Wastes also migrate into stream systems and may be transported to residential areas near streams during flood events. Mining wastes are prevalent in the western areas of the Baxter Springs community; thus, most of the residential effort was targeted in this area. Properties with lead values exceeding 800 ppm lead or 75 ppm cadmium were excavated until lead and cadmium levels were less than 500 and 25 ppm, respectively, or until a maximum excavation depth of one foot was achieved. Properties were backfilled with clean native soils and revegetated. The same criteria were utilized for residential work at other OUs of the Site. A total of 441 properties were sampled, and 47 yards were remediated at the Baxter Springs subsite.

The mine waste cleanup portion of the initial PRP response action included the removal of wastes from minor streams and drainages, draining and capping tailings impoundments, grading, consolidating, and capping chat piles followed by revegetation of all disturbed areas. The revegetation seed mixture consisted of tall, warm season, native grasses. The mine waste cleanup addressed mine waste accumulations that contributed major loadings to surface water bodies. Approximately 160 acres (or approximately 700,000 cubic yards) of mining wastes were remediated at the Baxter Springs subsite by PRPs.

A second PRP RA is ongoing for wastes not addressed by the first cleanup. This work is being conducted pursuant to a 2008 Settlement Agreement and Consent Agreement (Case No. 07-E-0059) between the PRP and KDHE. The PRP, Cyprus Amax Minerals Corporation (corporate successor is currently Freeport-McMoRan), submitted a Removal Action Report in 2011. Cleanup activities were completed in 2014 but some areas require maintenance prior to closure.

The first phase of EPA fund-lead remedial design (RD) and RA addressed both the Baxter Springs and Treece subsites and was completed in 2012. An EPA fund-lead RD was completed for the second phase in 2011 for both Baxter Springs and Treece subsites. The EPA is conducting the second phase RA that only addresses the Baxter Springs subsite. The second phase RA is scheduled to be completed in 2016. The EPA is currently implementing the third

phase mine waste RA for several hundred acres of wastes where there are no viable responsible parties.

OU 04, Treece Subsite

Many phases of work have been completed or are underway and being conducted by PRPs and the EPA at this subsite. The residential work at this OU was completed by PRPs under the same 1999 CD as the OU 03 work described above and is currently in the O&M phase. A total of 148 properties were tested and 41 yards were remediated. The residential cleanup was completed in 2000.

The first PRP response action consisted of a residential lead cleanup for the community of Treece, Kansas. The town of Treece is located near several former mining areas. Wastes from these areas were transported to residential locations for a variety of purposes such as driveway construction, landscaping, fill material, and alley/road construction. The remediation consisted of removing up to one foot of metals-impacted (lead, cadmium, and zinc) soils from residential yards followed by placement of clean backfill soils and revegetation. Additional components included a well search to determine if any residents in the Treece area were consuming contaminated water from private water wells, followed by the abandonment of these wells when identified. Any deep wells providing a conduit to transmit contaminated water from the upper aquifer to the lower pristine aquifer were to be abandoned under the Treece cleanup. Well search activities did not identify any deep wells transmitting contaminants to lower clean aquifers or any residents consuming impacted groundwater. The town of Treece was served by a municipal water system that was regulated by the state and provided clean drinking water. Nonresidential mining wastes at the Treece subsite were not addressed by the PRP residential remedy.

The EPA completed a mine waste RA for several hundred acres in conjunction with the work described for OU 03 above. The second phase mine waste RA for OU 04 was completed in 2014 and is awaiting the completion of punch list items and inspections prior to completion of the operational and functional (O&F) period. The EPA is also conducting a RD for the next phase of cleanup that will address the remaining mine waste in the Treece subsite. A second CD with the PRPs was signed in October 2013. This document will ensure the implementation of a mine waste RA for several hundred acres of wastes at the Treece subsite. The PRP design work is completed and one PRP has begun cleanup action. The other PRP will begin on-site construction work in early 2016.

The EPA implemented a voluntary residential buy-out for the community of Treece, Kansas, that was conducted by KDHE. This work was specified in a 2010 Explanation of Significant Differences for the adjacent Tar Creek Superfund site in Oklahoma. Residential buy-outs for Oklahoma communities adjacent to Treece were historically conducted by EPA Region 6 and the state of Oklahoma. The influence of Oklahoma-based mining wastes upon the community of Treece lead to the modification of the EPA Region 6 Tar Creek ROD to address the impacts to Treece citizens. All buy-out activities in the community of Treece were concluded with the disbandment of the Treece Relocation Assistance Trust on May 22, 2014.

OU 05, Galena Groundwater/Surface Water

Work at this OU has been conducted by the EPA and PRPs and is in different phases.

The EPA fund-lead work at this OU is in the O&M phase and is being conducted by the state of Kansas. The remedy was completed in 1996 and transitioned to the O&M phase in 1997. The response action consisted of a fund-lead mine waste cleanup of approximately 900 acres of nonresidential land surrounding the community of Galena, Kansas. Mining wastes were segregated; and wastes less than 1,000 ppm lead were placed at the surface with more impacted wastes placed at depth or used as fill material for open dry shafts. Low concentration wastes or bull rock were used to fill shafts that were water filled. In general, large mine waste accumulations were regraded and redistributed; local drainages were enhanced by rip rap; new engineered drainages were created (geotextile lined with rip rap); open mine shafts and collapse features were filled with wastes; and the surface was revegetated following a series of inspections after completion of the remedy.

PRPs conducted a cleanup of the former Eagle-Picher smelter buildings and associated grounds pursuant to the terms of a 2006 bankruptcy settlement. The decontamination work of the buildings and remediation of the surrounding land areas has been completed. The decontaminated buildings are currently being reused by a local business. These activities were managed and overseen by KDHE. All work was completed in 2014. There is no O&M associated with the PRP work at this OU.

OU 06, Badger, Lawton, Waco, and Crestline Subsites

Work at this OU has been conducted by the EPA and PRPs. Two CDs – one for the Waco subsite and one for the Crestline subsite – were completed, and the PRPs conducted response actions under these decrees. The Badger and Lawton cleanups were conducted by the EPA as fund-lead RAs. All response work is complete and PRPs and the state of Kansas are conducting O&M activities.

The following describes the status of each of the four OU 06 subsites.

Badger/Lawton subsites – The EPA completed the RA. Approximately 680,000 cubic yards of wastes were addressed. Work at this subsite was combined with the Lawton subsite.

Waco subsite – The EPA and PRPs conducted response actions at this subsite. The PRP construction work was completed in 2012, and the EPA portion was completed in 2011. Approximately 975,000 cubic yards of wastes were addressed at the Waco subsite by the EPA and PRPs.

Crestline subsite – The PRP RA is complete. Approximately 250,000 cubic yards of wastes were addressed.

OU 07, Galena Residential Soils

This OU is in the O&M phase and consisted of a residential cleanup action using the same criteria as discussed above for OU 03 and OU 04. The presence of a smelter in the town of Galena was responsible for a much larger residential lead problem than at the other subsites due to the wind dispersion of smelter emissions over a large area. More than 1,500 properties were sampled in the Galena area and over 700 residential properties were remediated. Approximately 180,000 cubic yards of impacted residential soils were addressed. This work was conducted as an EPA fund-lead effort under a 1996 ROD and was completed by 2001.

System Operation/Operation and Maintenance

OU 01, Galena Alternate Water Supply

O&M: the rural water district performs O&M utilizing fees for services. The self-sustaining activities include routine maintenance of wells, pumps, buildings, and construction activities to connect new users. There are no known problems with the operation of the rural water district.

OU 03, Baxter Springs Subsite

Residential O&M: maintenance of the fenced soil repository located in Galena, Kansas, by KDHE.

Nonresidential O&M: inspect, monitor, and repair soil cap erosion problems and maintain vegetative growth on the cap. These activities are performed by PRPs currently and KDHE in the future for fund-lead areas.

OU 04, Treece Subsite

Nonresidential O&M: same as described for OU 03 above.

OU 05, Galena Groundwater/Surface Water

Nonresidential O&M: same as described for OU 03 above.

The vegetation and engineering enhancement studies are being conducted on areas with potentially high O&M costs. This includes steeply sloped locations, highly acidic areas, and locations with insufficient organic materials that are difficult to revegetate or maintain an adequate stand of vegetation.

OU 06, Badger, Lawton, Waco, and Crestline Subsites

Residential and nonresidential O&M: same as described for OU 03 above.

OU 07, Galena Residential Soils

Residential O&M: same as described for OU 03 above except that there is no PRP involvement at this OU.

Although O&M activities do not include collection of environmental samples, in order to assess the effectiveness of the remedy, a follow-up blood lead study was conducted by KDHE, the local Cherokee County Health Department, and the ATSDR in the community of Galena. The study was released in 2004 and illustrated the benefits of the completed residential cleanup by contrasting the results to an earlier ATSDR blood lead study conducted prior to the residential work. The geometric mean of blood lead levels in Galena children less than six years of age decreased from 4.13 micrograms per deciliter (µg/dl) to 2.29 µg/dl following the residential cleanup.

V. PROGRESS SINCE THE LAST REVIEW

The protectiveness statements provided in the 2010 FYR are provided in Table 2.

Table 2: Protectiveness Determinations/Statements from the 2010 FYR

OU #	Protectiveness Determination	Protectiveness Statement
01	Protective	The remedy at OU 01 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.
03	Will be Protective	The remedy at OU 03 is expected to be protective of human health and the environment upon completion.
04	Will be Protective	The remedy at OU 04 is expected to be protective of human health and the environment upon completion.
05	Protectiveness Deferred	A protectiveness determination of the completed remedy at OU 05 cannot be made at this time until further information is obtained. Vegetation and engineering enhancement studies will be conducted in 2011 and 2012. Protectiveness statements will be updated during the next five-year review.
05	Will be Protective	The PRP remedy at OU 05 is expected to be protective of human health and the environment upon completion.
06	Will be Protective	The remedy at OU 06 is expected to be protective of human health and the environment upon completion.
07	Protective	The remedy at OU 07 is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.
Sitewide	Will be Protective	The remedy at the Cherokee County Superfund Site is expected to be protective of human health and the environment upon completion.

Two issues were identified with recommended follow-up actions in the 2010 FYR report and are listed below with updates on the status of the actions.

Table 3: Status of Recommendations from the 2010 FYR

OU #	Issue	Recommendations / Follow-up Actions	Party Responsible	Oversight Party	Original Milestone Date	Current Status	Completion Date (if applicable)
05	Assess vegetation and engineering enhancements at portions of the completed remedy.	Continue assessing various amendments for use in optimally establishing vegetation at portions of the completed OU 05 remedy. Begin assessment of engineering enhancements for select portions of the completed remedy.	EPA/State	EPA	12/31/2012	Ongoing	N/A
05	Assess PRP bankruptcy funds with regard to the ongoing smelter and associated grounds design and cleanup.	Continue monitoring the use of funds and projected design and construction costs.	EPA/State	EPA	Ongoing	Completed	6/11/2014

Recommendation 1

The EPA and KDHE have continued discussions and research into amendments and engineering enhancements for use in optimally establishing vegetation at portions of the completed OU 05 remedy. These discussions are ongoing and this issue is carried forward in this FYR.

Recommendation 2

The smelter site was addressed under a bankruptcy settlement between Eagle-Picher Custodial Trust, KDHE, and the EPA, with KDHE taking the lead role for the environmental issues. An Evaluation of Remedial Alternatives investigation conducted in 2011 determined that the most cost-effective remedial solution would be to consolidate and cap the waste on site, preventing humans and wildlife from coming into contact with the wastes and preventing the migration off site. The excavation of approximately 194,000 cubic yards of smelter waste, contaminated soils and sediment was initiated in June 2013, and the encapsulation cell was completed in January 2014. The final inspection took place in June 2014.

VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

The state was notified of the initiation of the FYR in August 2014. The Cherokee County Superfund Site Five-Year Review was led by Elizabeth Hagenmaier of the EPA, a Remedial Project Manager for the Site. The FYR team includes the following individuals: Bryant Burnett, EPA Project Manager/Public Health Service Officer; Elizabeth Hagenmaier, EPA Project Manager; Todd Campbell, EPA On-Scene Coordinator; Bob Richards, EPA Attorney; Karim Dawani, EPA Community Engagement Specialist; Venessa Madden and Catherine Wooster-Brown, EPA Ecological Risk Assessors; Todd Phillips, EPA Human Health Risk Assessor. Bob Jurgens, KDHE Section Chief; Joe Dom, KDHE Unit Chief, and Chris Hase, KDHE Project Manager, assisted in the review as the representatives for the support agency.

The review, which began on August 25, 2014, consisted of the following components:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection; and
- Five-Year Review Report Development and Review.

Community Notification and Involvement

Activities to involve the community in the FYR process were initiated with a meeting in August 2014 between the RPM and Community Involvement Coordinator for the Site. A notice was published in the local newspaper, the "Cherokee County News-Advocate", on August 5, 2015, stating that there was a five-year review of the Site and inviting the public to submit any comments to the EPA. The results of the review and the report will be made available at the Site information repository located at:

Galena Public Library
315 West 7th Street
Galena, KS 66739

Johnston Public Library
210 West 10th Street
Baxter Springs, KS 66713

Columbus Public Library
205 N. Kansas Avenue
Columbus, KS 66725

Document Review

This FYR consisted of a review of relevant documents including O&M records and monitoring data. Applicable soil cleanup standards, as listed in the ROD and ROD Amendments for the Site, were also reviewed. A list of documents reviewed can be found in Appendix C.

Data Review

RAs completed to date include residential and nonresidential cleanups for all or portions of OUs 01, 03, 04, 05, 06, and 07.

In general, O&M activities at these completed remedies include visual inspection and maintenance of soil covers and the enforcement of institutional controls. The waterline is maintained by the City of Galena.

For remedies under construction, environmental data is collected and analyzed to determine if soil-specific cleanup levels have been met.

No data was evaluated as part of this FYR.

Site Inspection

Site visits conducted in 2014/2015 prior to the release of the FYR included members of the FYR team: EPA Project Managers, EPA On-Scene Coordinator, and KDHE Bureau and Branch Chiefs and Project Manager. The issue at the OU 05 remedy was observed during these inspections. No additional issues relevant to the FYR were noted.

Interviews

No site interviews were conducted for the fifth FYR.

VII. TECHNICAL ASSESSMENT

The technical assessment includes an analysis of the following three questions regarding the completed remedy: (A) is the remedy functioning as intended by the decision documents; (B) are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid; and (C) has any other information come to light that could call into question the protectiveness of the remedy. These three questions are addressed below.

Question A: Is the remedy functioning as intended by the decision documents?

Remedial Action Performance

OUs 01, 05, 07

These OUs encompass the Galena subsite.

The OU 01 waterline continues to function as intended. The system is maintained by the local municipality utilizing fees collected from its users.

In general, the soils remedies at OU 05 and OU 07 are functioning as intended. As is discussed in more detail below, the EPA and the State of Kansas continue to evaluate alternatives to stabilize soils and promote vegetation growth in certain areas of OU 05.

Blood lead testing of the target child population in Galena from 1991 and 2000 confirms a 44.6 percent reduction in the detection of elevated blood lead exceeding 10 µg/dl in Galena.

OUs 03 and 04

Currently, the RAs completed to date for OUs 03 and 04 are functioning as intended. The EPA and PRPs continue to execute work at both of these OUs. To date, for the remedy components that have been implemented, cleanup levels have been achieved, soil repositories are functioning with no significant operational issues, and O&M is ongoing.

OU 06

Currently, the RAs completed for OU 06 are functioning as intended. The executed RAs have achieved cleanup levels from the ROD. In addition, the soil repositories are functioning without significant operational issues, and O&M is ongoing.

System Operations/O&M

As was expressed in the last FYR, KDHE continues to be concerned over the extent and cost of the ongoing maintenance for the completed remedy. The O&M program currently being conducted by KDHE is being evaluated in terms of scope and cost in relation to historic expectations. Potential vegetation and engineering enhancements are currently being evaluated. The vegetation and engineering enhancement studies are being focused on areas with potentially

high O&M costs. This includes steeply sloped locations, highly acidic areas, and locations with insufficient organic materials that are difficult to revegetate or maintain an adequate stand of vegetation. The total area being evaluated consists of approximately 200 acres that will require various engineering (reduced slope/grade, addition of terraces) and revegetation (addition of soils/nutrients/fertilizers, refined seed mixtures) activities.

Implementation of Institutional Controls and Other Measures

Certain IC activities have been implemented at various subsites by KDHE and the Cherokee County Health Department. The efforts included the following components: health education regarding all aspects of lead exposure, blood lead testing, physician education on the awareness and symptoms of lead poisoning, in-home lead assessments performed by nurses from the county health department, provision of a high efficiency particulate vacuum upon request by county residents, and quarterly reporting of all aspects of the ICs program.

It should be noted that the ultimate ICs program at each OU at the Site includes other elements such as restrictions on the inappropriate use of chat mining wastes, land use controls in undermined areas and locations where wastes are capped, building permits, testing requirements for development in mining-impacted areas, and restrictions on use of the upper contaminated aquifer as a source of drinking water. All elements of the county-wide ICs program have not yet been implemented. Kansas Environmental Use Controls are being implemented in several OUs at the Site, and a county-wide restriction on the use of mining wastes for surface road cover is being implemented at all OUs.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy section still valid?

Changes in Standards and To Be Considereds (TBCs)

- *Have there been changes to risk-based cleanup levels or standards identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the RODs that call into question the protectiveness of the remedy?* There have been no changes that would call into question the protectiveness of the remedy.

- *Are there newly promulgated standards that call into question the protectiveness of the remedy?* No, there have not been any newly promulgated standards that call into question the protectiveness of the remedy.

- *Have TBCs been used in selecting cleanup levels at the site changed in a way that could affect the protectiveness of the remedy?* TBCs have not changed in a way that affects the protectiveness of the remedy. However, it is worth noting that in 2012, the Centers for Disease Control and Prevention followed the advice of its Advisory Committee on Childhood Lead Poisoning Prevention and adopted a new reference value of 5 µg/dL, based on the 97.5th percentile blood lead level in children ages 1 to 5. Currently, the EPA's health protection goal of no more than a 5% probability of exceeding a blood lead level of 10 µg/dL in a child or group of similarly exposed children is still valid. However,

the EPA is currently re-evaluating the goal, which may impact the protectiveness of the remedy in the future. TBCs used in the development of site-specific ecological cleanup levels have not changed.

Changes in Exposure Pathways

- *Has land use or expected land use on or near the site changed (e.g., industrial to residential, commercial to residential)?* We are not aware of any land use changes or any potential future land use changes at the Site.

- *Have any human health or ecological routes of exposure or receptors changed or been newly identified (e.g., dermal contact where none previously existed, new populations or species identified on site or near the site) that could affect the protectiveness of the remedy?* The *Assessing Protectiveness at Sites for Vapor Intrusion Supplement to the "Comprehensive Five Year Review Guidance"* (EPA, 2012) recommends evaluation of the vapor intrusion pathway during the FYR. For the Site, the contaminants of concern are not sufficiently volatile to pose a potential inhalation risk via the vapor intrusion pathway. No other new routes of exposure or receptors for the Site were identified.

- *Are there newly identified contaminants or contaminant sources?* The available data does not indicate any new contaminants or contaminant sources.

- *Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents (e.g., byproducts not evaluated at the time of remedy selection)?* We are not aware of any unanticipated toxic byproducts.

- *Have physical site conditions (e.g., changes in anticipated direction or rate of groundwater flow) or the understanding of these conditions (e.g., changes in anticipated direction or rate of groundwater flow) changed in a way that could affect the protectiveness of the remedy?* We have no information to indicate that site conditions or the understanding of these conditions has changed.

Changes in Toxicity and Other Contaminant Characteristics

- *Have toxicity factors for contaminants of concern at the site changed in a way that could affect the protectiveness of the remedy?* Several toxicity values have changed since the original risk assessment was conducted. However, the changes in toxicity values do not significantly change the results of the human health risk assessment and thus, do not impact the protectiveness of the remedy.

- *Have other contaminant characteristics changed in a way that could affect protectiveness of the remedy?* We are not aware of any other changes to contaminant characteristics that could impact the protectiveness of the remedy.

Changes in Risk Assessment Methods

- *Have standardized human health risk assessment methodologies changed in a way that could affect the protectiveness of the remedy?* The EPA has significantly revised its dermal risk assessment guidance since the completion of the original risk assessment (EPA, 2004). Also, because the risk assessment preceded Risk Assessment Guidance for Superfund (RAGS) Part F (U.S. EPA, 2009b), inhalation exposures were assessed on a body weight basis, instead of on a concentration basis. Although the method to assess inhalation exposures has changed, exposure to particulates suspended in outdoor air is generally very small compared to oral exposure. Therefore, because the inhalation pathway is a minor contributor to risk compared to ingestion at this site, these changes are unlikely to affect the protectiveness of the remedy. Additionally, the EPA has completed an update of standard default exposure factors (EPA, 2014); thus many of the exposure assessment input parameters in the original risk assessment are different than values currently recommended. Overall, these changes do not have a significant impact on the conclusions of the risk assessment and do not affect the protectiveness of the remedy.
- *Have standardized ecological risk assessment methodologies changed in a way that could affect the protectiveness of the remedy?* No, standardized ecological risk assessment methodologies have not changed in a way that could affect the protectiveness of the remedy.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Other Information

- *Are there newly identified ecological risks been found?* We are not aware of any newly identified ecological risks that could impact the protectiveness of the remedy.

- *Are there impacts from natural disasters (e.g., a 100-year flood)?* A tornado went through the city of Baxter Springs in April 2014. No previously remediated residential or non-residential properties were affected. Also, it did not impact any areas that were part of future cleanup activities.

- *Has any other information come to light which could affect the protectiveness of the remedy?* At this time, we are not aware of any other information which could affect the protectiveness of the remedy.

VIII. ISSUES

One issue was identified that impacts future protectiveness. This issue is identified below:

Issue No. 1: Assess vegetation and engineering enhancements at portions of the completed OU 05 remedy.

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommended actions to address the issue identified in Section VIII are provided below:

Recommendation for Issue No. 1: Continue assessing various amendments for use in optimally establishing vegetation and assessing engineering enhancements for portions of the completed OU 05 remedy.

X. PROTECTIVESS STATEMENTS

Protectiveness Statement(s)		
Operable Unit: 01	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The remedy at OU 01 is protective of human health and the environment.		

Operable Unit: 03	*Protectiveness Determination:* Will be Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The remedy at OU 03 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks have been addressed.		

Operable Unit: 04	*Protectiveness Determination:* Will be Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The remedy at OU 04 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks have been addressed.		

Operable Unit: 05	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The OU 05 remedy currently protects human health and the environment because highly contaminated soils have been excavated from residential and nonresidential properties. However, in order to be protective in the long term, O&M enhancements to 200 acres of steep terrain and/or areas with low nutrients soils need to be implemented to reduce O&M costs and promote vegetation growth.		

Operable Unit: 06	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The remedy at OU 06 is protective of human health and the environment.		

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
07	Protective	N/A
Protectiveness Statement: The remedy at OU 07 is protective of human health and the environment.		

XI. NEXT REVIEW

The next FYR report for the Cherokee County Superfund Site is required five years from the completion date of this review. The next FYR will be completed by September 2020.

FIGURE 1

CHEROKEE COUNTY SUPERFUND SITE

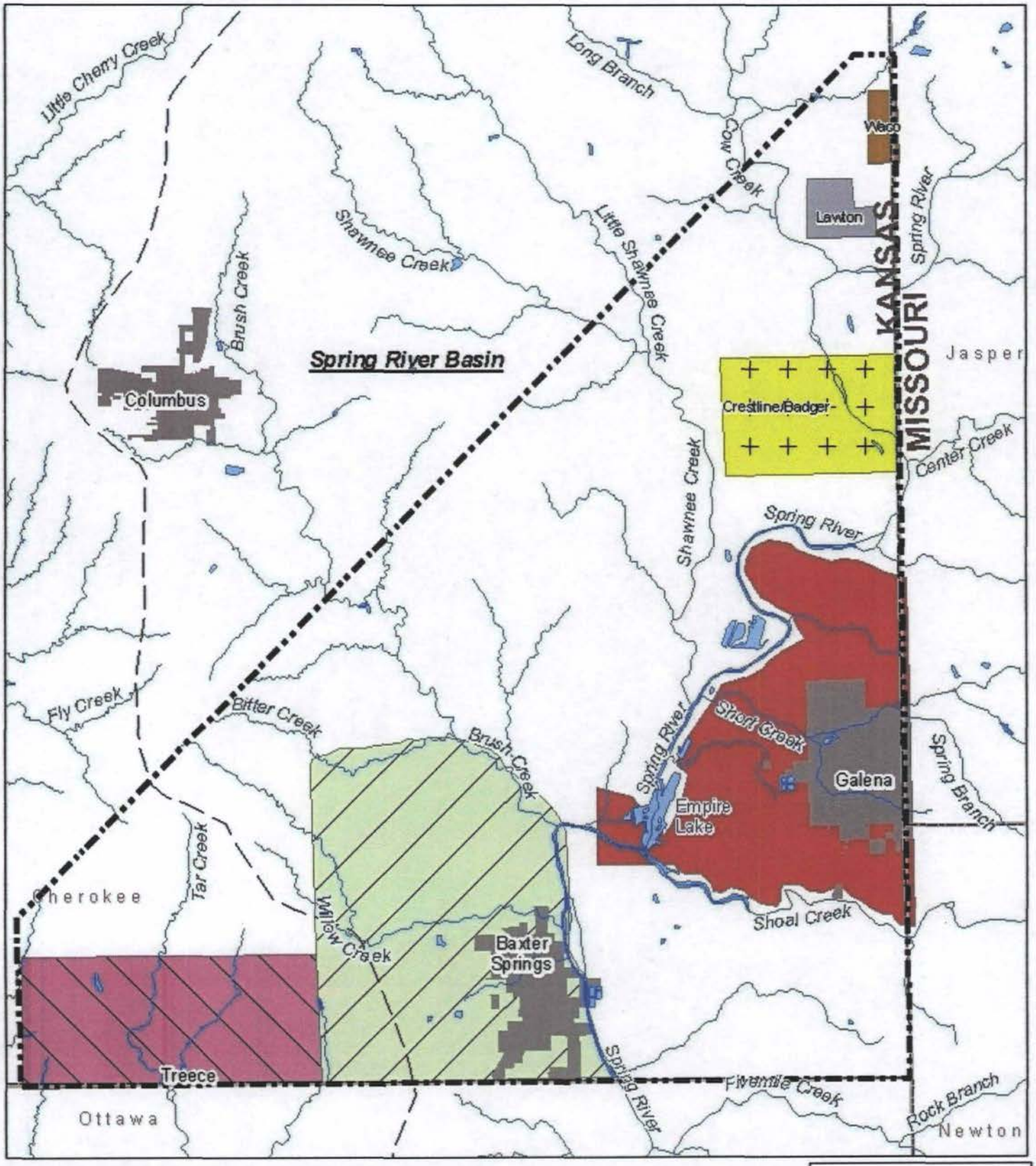
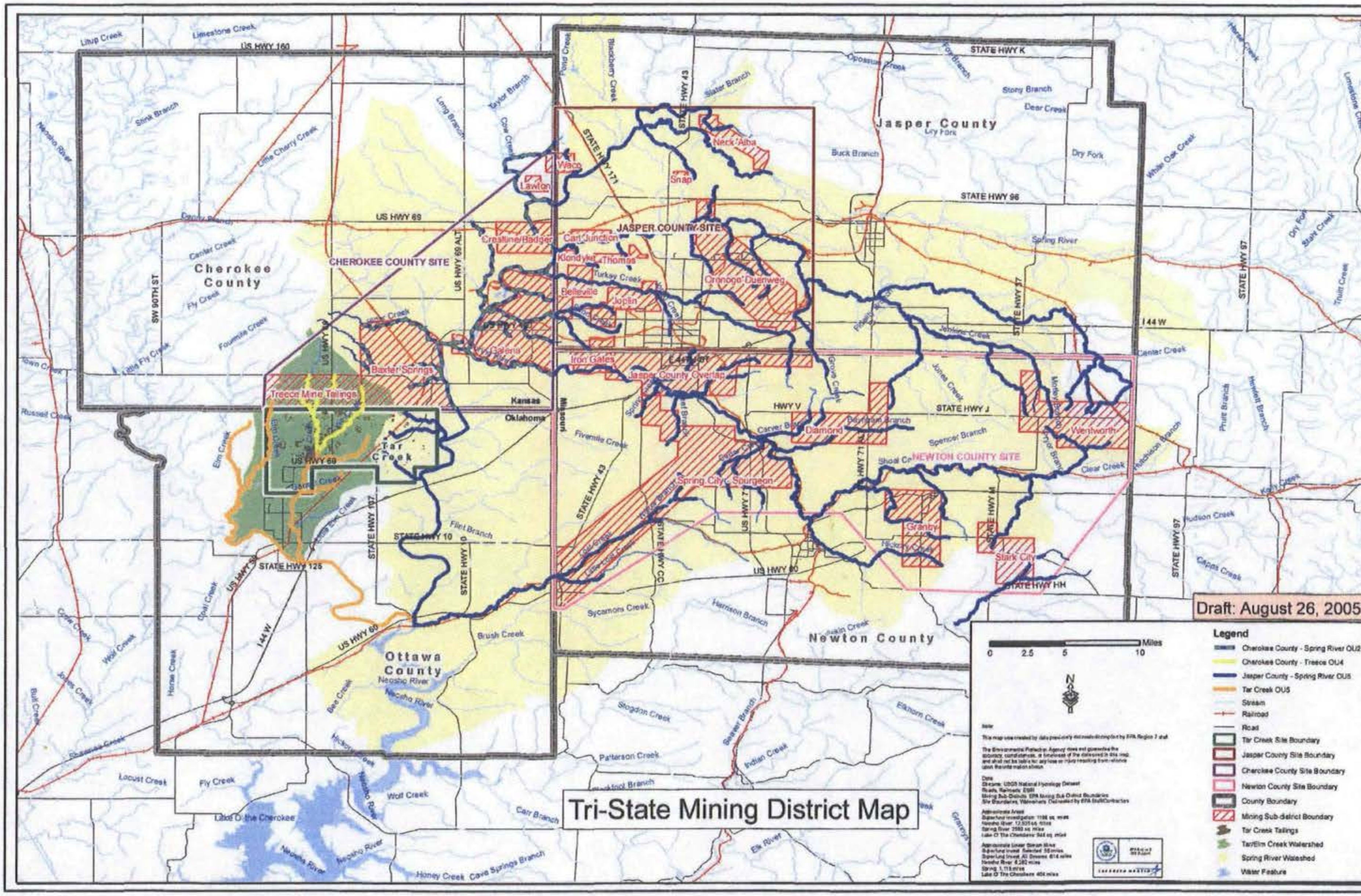

Little Cherry Creek
Long Branch
Cow Creek
Waco
Lawton
Spring River
KANSAS
MISSOURI
Shawnee Creek
Little Shawnee Creek
Brush Creek
Spring River Basin
Columbus
Jasper
Crestline/Badger
Center Creek
Spring River
Shawnee Creek
Fly Creek
Bitter Creek
Brush Creek
Short Creek
Spring River
Galena
Spring Branch
Empire Lake
Tar Creek
Cherokee
Willow Creek
Baxter Springs
Shoal Creek
Treece
Spring River
Turnpike Creek
Rock Branch
Ottawa
Newton
Site Location, Cherokee County, KS Superfund Site
Subsites:
Baxter Springs
Crestline/Badger
Galena
Lawton
Treece
Waco
Spring River Basin
Site Boundary
N
0 1 2 4 Mile
WO SF10-07-001 Task1 ZDong
Kansas
Missouri
Oklahoma
Arkansas

FIGURE 2

TRI-STATE MINING DISTRICT WATERSHED MAP



Tri-State Mining District Map
Draft: August 26, 2005
Jasper County
Cherokee County
Newton County
Ottawa County
JASPER COUNTY SITE
CHEROKEE COUNTY SITE
NEWTON COUNTY SITE
Kansas
Oklahoma
Missouri
Treece Mine Tailings
Tar Creek
Baxter Springs
Waco
Lawton
Neck Aba
Snap
Crestline/Badger
Carl Junction
Klondyke
Thomas
Turkey Creek
Belleville
Joplin
Oronogo Duenweg
Iron Gates
Jasper County Overlap
Diamond
Wentworth
Spring City - Spurgeon
Granby
Stark City
Spring River
Neosho River
Lake O' the Cherokee
US HWY 160
US HWY 69
US HWY 69 ALT
US HWY 60
US HWY 66
STATE HWY K
STATE HWY 96
STATE HWY 171
STATE HWY 43
STATE HWY 37
STATE HWY 97
STATE HWY J
STATE HWY 10
STATE HWY 125
STATE HWY 137
STATE HWY CC
STATE HWY HH
HWY V
I 44 W
SW 90TH ST
Miles
0 2.5 5 10
N
Legend
Cherokee County - Spring River OU2
Cherokee County - Treece OU4
Jasper County - Spring River OU5
Tar Creek OU5
Stream
Railroad
Road
Tar Creek Site Boundary
Jasper County Site Boundary
Cherokee County Site Boundary
Newton County Site Boundary
County Boundary
Mining Sub-district Boundary
Tar Creek Tailings
Tar/Elm Creek Watershed
Spring River Wateshed
Water Feature

APPENDIX A

SITE CHRONOLOGY

APPENDIX A – SITE CHRONOLOGY

Event	Date
Site added to NPL	1983
OU 01 Removal Actions	1987-1988
OU 01 ROD	12/21/87
OU 05 ROD	09/18/89
OU 01 RA Complete	1994
First FYR	1995
OU 07 Removal Action	1995-1996
OU 05 RA Complete	1996
OU 07 ROD	07/29/96
OU 03/04 ROD	08/20/97
OU 03/04 CD	1999
OU 04 PRP RD Complete	1999
OU 07 RD Complete	1999
Second FYR	2000
OU 04 PRP RA Complete	2000
OU 03 RD Complete	2001
OU 07 RA Complete	2001
OU 03 PRP RA Complete	2004
OU 06 ROD	09/30/04
Third FYR	2005
TSMD Watershed Work begins	2005
OU 02 Spring River/Tar Creek Report	2005
OU 05 Eagle-Picher Bankruptcy (Smelter Area funding)	2006
OU 02 Empire Lake report	2006
OU 03/04 ROD Amendment	09/29/06
OU 06 CD (Crestline)	2007
Chat Rule (Fed. Reg. Vol. 72, No. 137)	07/18/07
OU 06 PRP RD Complete (Crestline)	2007
OU 06 PRP RA Start (Crestline)	2007
OU 06 CD (Waco)	2007
OU 06 RA Start (Waco)	2008
KDHE/PRP Settlement/Consent Agreement (OU 03)	07/21/08
OU 03/04 RD Complete (Phase I)	2008
OU 03/04 RA Start (Phase I)	2008
OU 06 RD Complete (Badger/Lawton)	2009
OU 06 PRP RD Complete (Waco)	2009
OU 06 PRP RA Start (Waco)	2009
OU 05 Smelter Building Remediation Complete (PRP)	2009
OU 06 RA Start (Badger/Lawton)	2009
OU 06 RA Start (Waco)	2009

OU 03/04 RD Start (Phase II)	2009
OU 05 Smelter Grounds Characterization Report	2010
Tar Creek ESD (Treece Residential Buy-out)	04/13/10
OU 06 RA Complete (Crestline)	2010
Fourth FYR	2010
OU 03 RD Complete (Phase II)	2011
OU 06 PRP RA Complete (Crestline)	2011
OU 03 RA Start (Phase II)	2011
OU 03/04 RA Complete (Phase I)	2012
OU 04 RA Start (Phase II)	2012
OU 06 PRP RA Complete (Waco)	2012
OU 06 RA Complete (Badger/Lawton)	2012
OU 06 RA Complete (Waco)	2012
OU 08 RI/FS Start	2013
OU 03 RD Start (Phase III)	2013
OU 04 Consent Decree	10/03/13
OU 04 RA Complete (Phase II)	2014
OU 04 PRP RD Start (Blue Diamond/Blue Mound)	2014
OU 04 PRP RD Start (Robinson/Jarrett)	2014
OU 03 RD Complete (Phase III)	2015
OU 03 RA Start (Phase III)	2015
OU 04 PRP RD Complete (Blue Diamond/Blue Mound)	2015
OU 04 PRP RD Complete (Robinson/Jarrett)	2015
OU 04 PRP RA Start (Blue Diamond/Blue Mound)	2015
OU 04 PRP RA Start (Robinson/Jarrett)	2015
Fifth FYR	2015

APPENDIX B

ROD AND RAO SUMMARIES

APPENDIX B – ROD AND RAO SUMMARIES

OPERABLE UNIT	DATE	SUMMARY OF RAOs
OU 01, Galena Alternate Water Supply	12/21/87	Provide suitable drinking water to the population within the subsite. Protect the deep aquifer during remedy implementation.
OU 03/04, Baxter Springs and Treece Subsites	8/20/97	Prevent exposure to impacted source materials, soils, and surface water.
OU 03/04, Baxter Springs and Treece Subsites	9/29/06 (ROD Amendment)	Prevent exposure to impacted source materials, soils, and surface water.
OU 05, Galena Groundwater/Surface Water	9/18/89	Reduce risks associated with exposure to soil, surface water, and groundwater contaminants. Protect the deep aquifer and enhance surface water quality.
OU 06, Badger, Lawton, Waco, and Crestline Subsites	9/30/04	Prevent exposure to impacted soils, source materials, surface water, sediments, and groundwater.
OU 07, Galena Residential Soils	7/29/96	Reduce public exposure and particularly children's exposure, to residential soils with elevated lead and cadmium resulting from past mining, milling, and smelting activities.
Tar Creek Superfund site (ESD covers the voluntary residential relocation of Treece, Kansas)	4/13/10	Prevent exposure to source material, transition zone soil, and soil which underlie source material. Prevent exposure to impacted soil and groundwater.

APPENDIX C

LISTING OF DOCUMENTS REVIEWED

APPENDIX C – LISTING OF DOCUMENTS REVIEWED

Angelo, R.T. et. al. 2007. Residual effects of lead and zinc mining on freshwater mussels in the Spring River Basin (Kansas, Missouri, and Oklahoma, USA). Science of the Total Environment 384: 467-496.

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Pope, L.M. 2004. Assessment of Contaminated Streambed Sediment in the Kansas Part of the Historic Tri-State Lead and Zinc Mining District, Cherokee County, KS, 2004. U.S. Geological Survey, Scientific Investigations Report 2005-5251.

Schaider, L.A. et. al. 2007. Characterization of zinc, lead, and cadmium in mine waste: Implications for transport, exposure, and bioavailability. Environmental Science and Technology 41 (11): 4164-4171.

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