UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6

RECORD OF DECISION
OPERABLE UNIT 4
CHAT PILES, OTHER MINE AND MILL WASTE, AND SMELTER WASTE
TAR CREEK SUPERFUND SITE

OTTAWA COUNTY, OKLAHOMA
OKD980629844

February 20, 2008

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LIST OF ACRONYMS AND ABBREVIATIONS

ALM	Adult Lead Methodology
AOC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BIA	Bureau of Indian Affairs
BHHRA	Baseline Human Health Risk Assessment
BLLs	Blood Lead Levels
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHAMP	Community Health Action and Monitoring Program
COC	Chemicals of Concern
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DOI	Department of the Interior
ELCR	Excess Lifetime Cancer Risk
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ESD	Explanation of Significant Difference
ft/day	feet per day
FR	Federal Register
FS	Feasibility Study
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
HRS	Hazard Ranking System
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
LDR	Land Disposal Regulations
LICRAT	Lead Impacted Communities Relocation Assistance Trust
LNAPL	Light Non-Aqueous Phase Liquid
LOAEL	Lowest-Observed-Adverse-Effect Level
MCL	Maximum Contaminant Level
mg/kg	milligram/ kilogram
mg/l	milligram/liter
µg/l	microgram/liter
MSHA	Mine Safety and Health Administration
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NOAEL	No Observable Adverse Effects Level
NPL	National Priorities List
O&M	Operation and Maintenance
ODEQ	Oklahoma Department of Environmental Quality
OPA	Oil Pollution Act
OW	Oily Water
OWRB	Oklahoma Water Resources Board
PPRTV	Provisional Peer Reviewed Toxicity Values
PRGs	Preliminary Remedial Goals
PRP	Potentially Responsible Party
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfC	Reference Concentration
RfD	Reference Dose

RG	Remediation Goals
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SF	Slope Factor
Site	Tar Creek Superfund Site
SLERA	Screening Level Ecological Risk Assessment
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile Organic Compound
TAG	Technical Assistance Grant
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UCL	Upper Confidence Limit
UIC	Underground Injection Control
URA	Uniform Relocation and Real Property Acquisition Policies Act
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WRDA	Water Resources Development Act of 2007

PART I: THE DECLARATION

1.0 SITE NAME AND LOCATION

The Tar Creek Superfund Site is located in Ottawa County, Oklahoma. The National Superfund Database Identification Number is OKD980629844.

2.0 STATEMENT OF BASIS AND PURPOSE

This decision document presents the "Selected Remedy" for the Tar Creek Superfund Site (hereinafter "the Site," Figure 1 - Site Location Map) which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 United States Code §9601 et seq., as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, as amended. This decision is based on the Administrative Record for Operable Unit 4 of the Site.

The State of Oklahoma, acting through the Oklahoma Department of Environmental Quality (ODEQ), concurs with the selected remedy.

3.0 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.

4.0 DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy for Operable Unit 4 is Alternative 5 -- Voluntary Relocation, Phased Consolidation, Chat Sales and On-site Disposal as presented in the Proposed Plan, July 30, 2007, with the following modifications: (1) relocation under the Selected Remedy is exempt from the Uniform Relocation and Real Property Acquisition Policies Act (URA)[1] and (2) the timeframe for chat sales is extended to 30 years. To emphasize the continuity in our remedy selection process, EPA will continue to refer to the Selected Remedy in this ROD as Alternative 5.

The Preferred Alternative 4 did not include voluntary relocation. However, based on State, Tribal and community concerns as well as changes in the cost effectiveness of relocation following the enactment of WRDA, EPA has included relocation in its Selected Remedy for the Site. Preferred Alternative 4 also limited chat sales to 20 years. However, since the residents facing the greatest risk of exposure will be relocated, the EPA has extended the timeframe for chat sales to 30 years in its Selected Remedy. The remaining elements of the Selected Remedy are identical to Alternative 4.

If a Selected Remedy involves a significant change to a feature of the Preferred Alternative proffered to the public in the Proposed Plan for a Superfund Site, EPA's policy is that the ROD is to indicate the significant changes made, and should provide a rationale for the changes (*e.g.,* new information or arguments provided in public comments). EPA is providing such a rationale in Section 21 of this ROD. In this case, EPA generally did not change the Preferred Alternative, but only added to it (*i.e.,* EPA added relocation and new timeframes for implementation). In addition, the addition of relocation could have been reasonably anticipated based on the extensive discussions of relocation originally presented in the Proposed Plan, in the Remedial Investigation and Feasibility Study Reports (RI/FS), and in the Administrative Record file.

[1] The Water Resources Development Act of 2007 (WRDA) Section 3135 exempts the relocation at the Site from the URA.

The Selected Remedy will address source materials, rural residential yard contamination, transition zone soil contamination, and contamination in water drawn from rural residential wells. "Source material," as used in this Record of Decision, means mine and mill waste including chat, fine tailings, overburden, development rock, smelter waste and other tailings. Source material is generally found in chat piles, chat bases (the area once occupied by a chat pile), smelter wastes, and tailings ponds as shown in Figure 2. These materials contain hazardous substances that are a source of OU4 contamination. The Selected Remedy is estimated to cost $167,288,000.

The Selected Remedy will utilize various elements to include the following:

PHASE 1

Phase 1 will address voluntary relocation of residents, chat sales, and address source materials in a manner that will reduce the overall footprint of contamination and reduce the need for land use restrictions, institutional controls, and operation and maintenance.

- Residents located in Picher, Cardin and Hockerville will be voluntarily relocated following the procedures and priorities established by the Lead Impacted Communities Relocation Assistance Trust (LICRAT).
- Chat and chat bases from distal areas (Figure 3), including associated historic chat covered haul roads and non-operating railroad grades, will be excavated to the underlying native soil, transported and released to an on-site chat processor or future processing location located in a previously contaminated area of the Site, injected into mine workings, or disposed in an on-site repository.
- Transition zone soils (soils around and underneath source materials) will be addressed by excavation followed by natural soil rebuilding.
- Smelter wastes will be excavated and disposed in an on-site repository. Smelter affected soils will be managed in the same manner as transition zone soils.
- Fine tailings will be injected into mine workings or covered in place. The covered fine tailings may be consolidated to reduce the footprint of the final cover.
- Source material in Tar, Lytle, Elm or Beaver Creek or other Site waterways, will be addressed on a priority basis through either excavation and/or the installation of a flexible membrane liner, as needed as determined by EPA. As an interim measure, sheet piling, berms, constructed wetlands, or other engineering controls will be installed for near-stream source materials to help prevent contamination from migrating to surface water.
- An alternative water supply will be provided to any household where mining-related contaminants in water drawn from rural residential wells exceed 0.015 mg/L for lead for rural households. Rural households that are within the area that has been designated for relocation under the Lead Impacted Communities Relocation Assistance Trust (LICRAT) relocation program, but which do not elect to participate in the relocation program, would be included in the households eligible for an alternative water supply (estimated two residences).
- Rural residential yards that are found to have concentrations of soil lead that exceed 500 ppm will be excavated to a maximum depth of 12 inches, and the excavated area will be backfilled with clean soil, contoured to promote drainage and revegetated. This includes residential yards that are identified for relocation. The provisions of the preceding sentence apply to approximately 4 households, based on the RI sampling. That is, if those eligible for relocation decide not to relocate, their yards will be remediated.
- On-site repositories will be constructed to accept Site source materials for final disposal. On-site repositories will be closed when they reach capacity or at completion of the remedial action. Closure will be accomplished by covering the repository with a soil cover, contoured to promote drainage, and revegetated.

PHASE 2

Phase 2 addresses certain source areas that remain after Phase 1 cleanup activities. These areas may include chat bases, tailings ponds, unmarketable chat piles and bases, and remaining chat from distal area consolidation. Chat sales will continue.

- The remedy will be reviewed, at a minimum, every five years since hazardous substances remain on-site with concentrations that exceed concentration levels that allow for unrestricted use and unrestricted exposure. The remedy will be reviewed to ensure protection of human health and the environment. As part of the five-year review, EPA will evaluate the progress of chat sales. Chat piles and bases remaining after 10 years will be evaluated for commercial viability. This determination will be made using input from the chat/land owners, appropriate tribal representatives, and the commercial operators.
- Unmarketable chat piles and bases will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or they will be disposed in an on-site repository.
- Abandoned chat haul roads and non-operating railroad grades that are contaminated will be managed the same as unmarketable chat piles and bases. That is, they will be excavated, transported to an on-site chat processor, and released to that processor, or they will be disposed in an on-site repository.
- Institutional controls and operation and maintenance activities will be implemented, as needed as determined by EPA, at repositories and covered, fine tailings ponds.
- Environmental monitoring will be conducted, as needed as determined by EPA, to test for contamination in ambient and near source air, surface water, ground water, and sediment during remediation activities.

5.0 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

High concentrations of lead are addressed under the Selected Remedy; however, the concentrations of lead are not so high as to be several orders of magnitude above levels that allow for unrestricted use and unlimited exposure. Therefore, the lead is not considered to be a principal threat under the NCP; consequently, there is no expectation under the NCP that the lead be treated.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

6.0 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision (Part 2). Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations (pages 13-17)
- Baseline risk represented by the chemicals of concern (pages19-24)
- Remediation Goals established for chemicals of concern and the basis for these levels (pages 27-29)
- How source materials constituting principal threats are addressed (page 45)

- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the Baseline Human Health Risk Assessment and ROD (page 18)
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy (page 55)
- 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 (page 45)
- Key factor(s) that led to selecting the remedy (i.e. a description of the Selected Remedy that explains how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (page56)

7.0 AUTHORIZING SIGNATURE

This ROD documents the Selected Remedy for the Tar Creek Superfund Site. This remedy was selected by the Environmental Protection Agency (EPA) with the concurrence of the Oklahoma Department of Environmental Quality. The Director of the Superfund Division (EPA, Region 6) has been delegated the authority to approve and sign this ROD.

U.S. Environmental Protection Agency (Region 6)

By: Samuel Coleman 2/20/08

Samuel Coleman, P.E., Director
Superfund Division (6SF)

Date

PART 2: THE DECISION SUMMARY

This Decision Summary provides a description of the site-specific factors and analyses that led to the selection of a remedy for chat piles, other mine and mill waste, and smelter waste at the Site. It includes background information about the Site, the nature and extent of contamination found at the Site, the assessment of human health and environmental risks posed by the contaminants at the Site, and the identification and evaluation of remedial action alternatives for the Site.

Due to the complex nature of contamination associated with the Tar Creek Site, remediation has been handled through various removal response actions and remedial actions. The following five operable units (OUs) have been designated at the Site: OU1 - surface water/ground water; OU2 – residential areas; OU3 - Eagle-Picher Office Complex (abandoned mining chemicals); OU4 - Mine and Mill Waste, and Smelter Waste and, OU5 - Sediments. A ROD was signed for OU1 in 1984 that addressed the surface water degradation of Tar Creek and the threat of contamination to the drinking water. This OU1 remedy is in an after-action monitoring phase. The ROD for OU2 was signed in 1997 and has addressed lead-contaminated soils at more than 2,295 homes and properties. OU3 was a removal action that requires no further action, and OU5 is currently in the early site characterization phase.

8.0 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Tar Creek Superfund Site (OKD980629844) is a former lead and zinc mining area located in Ottawa County, Oklahoma. The Site is part of the Tri-State Mining District located at the junction of Oklahoma, Kansas, and Missouri. The Site has no clearly defined boundaries, but consists of the areas of Ottawa County impacted by mining waste. The Site includes all of the area (approximately 40 square miles) in northern Ottawa County where lead and zinc mining operations were conducted and any area where a hazardous substance from mining or milling in Ottawa County has been stored or disposed. This ROD for OU4 focuses on the 40 square mile area which is generally depicted in Figure 1. The Site also includes all suitable areas in very close proximity to the contamination necessary for implementation of the response action. The Site is bounded by the State of Kansas to the north. The principal Site communities include Cardin, Commerce, North Miami, Picher, and Quapaw. Approximately 19,556 people live on-site in the mining area and in communities in proximity to the mining area (**EPA, 2004**).

EPA is the lead agency and ODEQ is the support agency for Operable Unit 4. Some of the Potentially Responsible Parties (PRPs) identified for the Site did participate in the remedial process for Operable Unit 4 by undertaking the Remedial Investigation and by preparing a draft Feasibility Study. EPA implemented the human health and ecological risk assessments at the Site and completed the Feasibility Study.

Mine and mill wastes are located throughout the Site. Some areas have chat, a type of waste tailings produced by the gravity separation milling process, in piles up to 200 feet high. Other areas of the Site include agricultural or residential properties. Mine and mill wastes are typically located adjacent to the former mines which are concentrated near the town of Picher, but are also scattered throughout the rest of Ottawa County.

9.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section of the ROD provides the history of the Site and a brief discussion of the EPA's removal, remedial, and enforcement activities.

9.1 History of Site Activities

The first ore discoveries and earliest mining operations in Ottawa County, Oklahoma occurred in the vicinity of Peoria (6 miles east and 1 mile south of Lincolnville) in 1891 (Weidman, 1932). The next major ore discoveries occurred 1.5 miles northeast of Lincolnville near Quapaw in 1902, followed by discoveries in 1905 near Commerce. The real expansion of zinc and lead mining at the Site occurred after a major ore

discovery in 1914 near the current site of Picher, Oklahoma. Following this discovery, there was a major expansion of mining in what became known as the Picher Mining Field (Picher Field) of Oklahoma and Kansas. By 1918, the Oklahoma section of the Picher Field was well defined by producing mines, with 230 mills built or under construction (Luza, 1986).

Depletion of high-grade ores caused a marked decline in annual production after 1946, and depressed metal-market prices forced a cessation of most mining activities in 1958 (Brichta, 1960). The last record of significant production from Ottawa County occurred in 1970 (McKnight and Fischer, 1970).

With few exceptions, the crude ore produced at the Site was mined utilizing underground mining methods. Based on production records maintained by the U.S. Department of Interior, Bureau of Mines, a total of 181,048,872 tons of crude ore was produced from the Oklahoma portion of the District. Milling of this ore produced 8,884,898 tons of zinc concentrates and 1,686,713 tons of lead concentrates. With the exception of a limited amount of lead concentrates treated at the Ontario Smelter, all of the concentrates produced from the Site were transport off-Site for the conversion of the concentrates to metal by smelting.

The by-products of the mining operation were discarded mining and milling tailings. The mill tailings, locally know as chat, are primarily composed of small chert fragments, intermingled with sand-sized particles. After the excavated rock was processed and the metal ore extracted, the mining tailings that remained were deposited into piles that were up to 200 feet in height. Many of these chat piles remain on the Site, including some piles which are over 100 feet high. An inventory conducted in 2005 as part of the Remedial Investigation for OU4 identified 83 chat piles occupying 767 acres with 31 million cubic yards, 243 chat bases (or former piles) occupying 2079 acres with an estimated 6.7 million cubic yards.

In addition to piles of mining wastes, a large but lesser quantity of floatation pond tailings from the floatation milling process was produced. Most of the floatation ponds have since evaporated leaving behind a very fine mining waste sediment which remains on the Site. Fine tailings generated from milling and washing chat are currently found in 63 ponds occupying 820 acres and total approximately 9 million cubic yards.

Over the years, the mining wastes have been used and continue to be used for a variety of purposes including the following: railroad ballast; concrete and asphalt aggregate; sandblasting sand; sandbag sand; roadway, driveway, alleyway, and parking lot aggregate; general fill material in residential areas; and impact-absorbing material in playgrounds.

The Site first came to the attention of the State of Oklahoma and EPA in 1979 when acid mine drainage began flowing to the Site surface from underground mines through abandoned mine shafts and boreholes. The Governor of Oklahoma formed the Tar Creek Task Force to investigate the effects of acid mine drainage on the area's surface and ground water. Based upon the information discovered by the Tar Creek Task Force, EPA proposed, in July 1981, to add the Site to the Superfund National Priorities List (NPL), 40 CFR Part 300, Appendix B. The NPL means the list, compiled by EPA pursuant to CERCLA section 105, of uncontrolled hazardous substance releases in the United States that are priorities for long-term remedial evaluation and response. The Site was added to the NPL in September 1983.

9.2 History of Federal and State Investigations and Removal/Remedial Actions

Due to the complex nature of contamination associated with the Tar Creek Site, remediation has been handled through various removal response actions and Remedial Actions (RA). The following five operable units or OUs have been designated at the Site: OU1 - surface water/ground water; OU2 – residential areas; OU3 - Eagle-Picher Office Complex (abandoned mining chemicals); OU4 - Mine and Mill Waste, and Smelter Waste and, OU5 - Sediments. RODs have been signed for OU1 and OU2, OU3 was a removal action that requires no further action, and OU5 is currently being assessed. To address the concerns of the State and the Tribes for the sediment and surface water downstream of the central mining area, OU5 will examine the nature and extent of contaminated sediment in Elm Creek and Tar Creek

starting at the confluence of Tar Creek and Lytle Creek to the Neosho River down to the point where it flows into Grand Lake.

In 1984, EPA issued its first Site Record of Decision (ROD). The 1984 ROD applied to two concerns which are now referred to as Operable Unit 1 (OU1): 1) the surface water degradation of Tar Creek, a stream located on the Site, by the discharge of acid mine water; and 2) the threat of contamination to the Roubidoux Aquifer, a drinking water source. Pursuant to EPA's 1984 ROD, dikes were constructed to reduce the inflow of surface water to certain mine shafts on the Site and to reduce the outflow of acid mine drainage from the subsurface to Tar Creek. In addition, abandoned wells that went through the Boone Aquifer to the deeper Roubidoux formation were plugged to prevent contamination from the Boone from seeping through cracked well casings and reaching the Roubidoux, a drinking water source. Abandoned wells that could threaten the Roubidoux are still being discovered and plugged as part of the After Action Monitoring Program for OU1.

In 1994, Indian Health Service test results concerning the blood lead levels of Indian children living on the Site indicated that approximately 35 percent of the Indian children tested had concentrations of lead in their blood exceeding 10 micrograms per deciliter (µg/dL). In August 1994, to address the threat of lead exposure to children, EPA began sampling soils at High Access Areas (HAAs) on the Site such as day cares, schoolyards, and other areas where children congregate. EPA sampled 28 HAAs between August 1994 and October 1994. The sampling detected significant concentrations of lead, cadmium, and other heavy metals in surface soils. In March 1995, EPA expanded its sampling activity to include all residences on the Site.

In 1995, EPA began to excavate contaminated soil at HAAs and at Site residences using its removal action authority. Concurrently, EPA began a Remedial Investigation/Feasibility Study for Site residential areas, referred to as Operable Unit 2 (OU2). In 1997, EPA issued a ROD to address contaminated soil in the residential areas of OU2. Under the removal actions and under the OU2 ROD, EPA has excavated lead-contaminated soil at more than 2,295 homes and properties. The remediation of the yards and the public areas and the education and outreach programs implemented by the Ottawa County Health Department are helping to protect the children's health. In 1996, data from the Oklahoma State Department of Health (OSDH) showed that among young children (aged 1-5 years) living at the site, 31.2% had a blood lead level at or above 10 micrograms per deciliter (µg/dL), the Centers for Disease Control and Prevention (CDC) level of health concern. By 2003, OSDH data indicated that elevated blood lead levels among children in the same age group had dropped to just 2.8%.

OU3 was a removal action that addressed lab chemicals in an abandoned office building on the Site.

Under the statutory requirements of Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and its implementing regulation 40 CFR § 300.430(f)(4)(ii), every five years, EPA is required to review sites it has addressed under Superfund where hazardous substances remain on-site above concentration levels that allow for unrestricted use and unrestricted exposure. Three five-year reviews have been performed at the Tar Creek Site. The first review was completed in April 1994, the second five-year review was completed in April 2000 and the third review was completed in September 2005. The most recent Five-Year Review Report is available online at http://www.epa.gov/earth1r6/6sf/pdffiles/tc_5yr_2005-09.pdf

A Memorandum of Understanding was signed in May 2003 between the EPA, the DOI, and the U.S. Army Corps of Engineers. The purpose of this Memorandum is to facilitate a coordinated response to environmental contamination, physical safety concerns (open mine shafts, subsidence, and flooding), and poor economic conditions at the Tar Creek area.

9.3 History of CERCLA Enforcement Activities

9.3.1 Operable Unit 1

The previous work at the Site under OU1 addressed the on-Site surface water impacted by mine discharges and the ground water on the Site. The EPA entered into a consent decree under Sections 107 and 122 of the

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C.§§ 9607 and 9622, with six mining companies (hereinafter the Companies), settling their liability for costs paid by the United States in responding to the release or threat of release of hazardous substances as described in the 1984 ROD (i.e., the costs related to OU1). In 1996, EPA settled its claims regarding the Site with a bankrupt mining company which had the largest operation at the Site.

9.3.2 Operable Unit 2

On August 25, 1995, EPA issued a notice to the Companies or to their corporate successors (hereinafter the Companies and their corporate successors are referred to as the Companies), and to the U.S. Department of the Interior (DOI) which may be a potentially responsible party (PRP) under CERCLA's liability provisions. In that notice, EPA gave the Companies and DOI the opportunity to conduct or finance the removal activities described in EPA's August 15, 1995, Action Memorandum. The Action Memorandum generally called for the excavation and on-Site disposal of lead-contaminated soil in High Access Areas (HAAs) (HAAs are areas which children frequently visit such as playgrounds, day-cares, and parks). The Companies and DOI did not undertake the removal; consequently, EPA proceeded with the removal action for the HAAs on its own.

The EPA also issued a Special Notice to the Companies and to DOI on November 17, 1995. In the Special Notice, EPA gave the Companies and DOI the opportunity to undertake the Remedial Investigation and Feasibility Study (RI/FS) and remedial design (RD) for the remedial response action to address contamination in the residential areas on the Site. The Companies and DOI did not undertake the RI/FS/RD. As an alternative to RI/FS/RD, the Companies and DOI offered to perform a Community Health Action and Monitoring Program (CHAMP). The CHAMP generally calls for monitoring the health of the children in the contaminated residential areas, for thorough cleaning of homes in the contaminated area, and for education of the residents regarding the avoidance of contamination. The EPA encouraged the Companies and DOI to undertake the CHAMP, which they did; but, housecleaning and education do not provide the sort of permanent remedy that the Superfund law requires. Consequently, EPA went forward with RI/FS/RD on its own.

In order to address the imminent and substantial endangerment to human health posed by the lead-contaminated soil in the residential areas on the Site, EPA issued a March 21, 1996, Action Memorandum calling for a removal action to address the contamination. At the time the Action Memorandum was issued, EPA sent a letter to the Companies and DOI notifying them that EPA was proceeding with the removal in residential yards. In the letter, EPA told the Companies and DOI that EPA would not delay the removal action in order to negotiate; however, EPA gave the Companies and DOI the opportunity to conduct or finance the removal activities in progress. The Companies and DOI did not offer to take over the removal actions.

9.3.3 Operable Unit 4

On December 9, 2003, the EPA signed an Administrative Order on Consent (AOC) with three Potentially Responsible Parties (PRPs), including DOI, Blue Tee Corp., and Gold Fields Mining Corporation, to conduct the Remedial Investigation/Feasibility Study (RI/FS) for OU4. Under the terms of the AOC, the EPA prepared the risk assessments for OU4 based on data collected by the PRPs and EPA.

A three-phased Site Reconnaissance was conducted from March 29 to April 28, 2005. During the Site Reconnaissance, field characterization of the mine and source materials was conducted and sampling sites for the Remedial Investigation were selected with concurrence of EPA, the ODEQ, the Quapaw Tribe and other participating organizations. Field sampling and investigations were conducted in May and concluded in October 2005.

During the course of the investigation, EPA performed a pilot project consisting of several field studies regarding sub-aqueous chat and fine tailings disposal, to supplement the Feasibility Study efforts. Under this pilot, EPA injected the source material into flooded mine cavities to determine whether this could be a cost-effective disposal technique. Characterization data collected prior to injection found conditions that are favorable to this technique. The mine water was circumneutral with a pH between 6.0 and 6.6, the

dissolved oxygen was very low (<50 µg/L) and oxidation/reduction potential measurements were less than -200 mV indicating an anaerobic environment. These types of conditions are conducive to a sulfate reducing environment which would prevent the dissolution of metals from the chat or tailings that are injected. A modified SPLP test was also conducted with the chat and fine tailings using mine water as the extracting fluid to estimate the amount of metals that could be released.

Following the pilot injection, EPA found that the physical placement of chat and fine tailings in flooded mine rooms does initially impact mine water; however, the data indicate that the mine water chemistry rapidly begins to return to pre-placement conditions. Following placement of chat, the water chemistry of the mine undergoes some increases in dissolved solids, largely from gypsum dissolution, and cadmium, lead, and zinc during the first flush of the chat material. The principal factors that control the amounts of trace elements entering the groundwater after chat placement are the abundance and availability of those elements in the chat piles.

The first flush impact to the mine water is expected to flow away from the emplaced chat at a rate of approximately 1 foot per day. The Boone Aquifer ground water model shows that for the EPA pilot sites the water would eventually discharge at the Neosho River in a period of approximately 100 years. The model does not account for sorption, dispersion, and diffusion of contaminants in the ground water. The concentrations of the metals from the "first flush" would be expected to decrease as the water flows toward the river; however, this scenario has not been fully evaluated.

In another ongoing pilot under the Remedial Investigation/Feasibility Study, DOI, with the cooperation of the Quapaw Tribe, is promoting responsible chat sales, using Best Management Practices to reduce the volume of millions of tons of mining waste. Both pilots, Indian-owned chat sales and the disposal of chat in mine cavities, were response action alternatives considered in the Feasibility Study.

10.0 COMMUNITY PARTICIPATION

This decision document or ROD presents the EPA-selected remedial action for the chat piles, other mine and mill waste and smelter waste areas of the Tar Creek Superfund Site, Ottawa County, Oklahoma chosen in accordance with CERCLA, as amended, and, to the extent practicable, the National Contingency Plan (NCP). The decision for the Site is based on the Administrative Record. The public participation requirements of CERCLA Subsection 113(k)(2)(B)(i-v) and 117, 42 U.S.C. Subsection 9613(k)(2)(B)(iv) and Section 9617, were met during the remedy selection process, as illustrated in the following discussion.

10.1 Community Involvement Plan

A Community Involvement Plan was prepared in February 1997. This plan describes the community involvement activities that the EPA has undertaken, and will continue to undertake, during the remedial activities planned for the Site.

10.2 Community Participation Activities

A Fact Sheet was distributed to the community in January 2004 to announce the beginning of the RI/FS. The Fact Sheet informed the public of the completion of an Administrative Order on Consent with DOI and two mining companies to implement the RI/FS for Operable Unit 4. EPA held a meeting on March 25, 2004, to discuss the RI/FS with the community.

The RI/FS and Proposed Plan for the Site were made available to the public in July 2007. These documents can be found in the Administrative Record File for the Proposed Plan and in the information repositories maintained with the ODEQ Central Records at the Oklahoma City Office, at the Miami Public Library, and at EPA's offices in Dallas, Texas (document repository addresses appear below in this ROD). The notice of the availability of these documents was published in the Miami News Record on July 28, 2007. The initial notice announced a 30-day public comment period ending August 30, 2007, but EPA extended that comment period an additional 32 days, until October 1, 2007, at the request of the ODEQ. EPA held a public meeting regarding the Proposed Plan on August 28, 2007, at Picher-Cardin High School.

At this meeting, representatives from EPA answered questions about the Site and the remedial alternatives outlined in the Proposed Plan. EPA response to the comments received during the public comment period for the Proposed Plan is included in the Responsiveness Summary (Part 3), which is part of this ROD.

10.3 Technical Assistance Grant

A Technical Assistance Grant (TAG) was awarded to the Local Environmental Action Demanded (LEAD) group in May 2001. The $50,000 grant was used by LEAD to hire a technical advisor and conduct community outreach. The grant expired in May 2004 and the remaining balance was de-obligated.

10.4 Local Site Repository

The purpose of the local Site Repository is to provide the public a location near the affected community to review and copy background and current information about the Site. The Site's repository is located near the Site at:

Miami Public Library
200 North Main St
Miami, OK 74354
Telephone Number: 918-542-3064

and at the ODEQ office at:

Oklahoma Department of Environmental Quality
707 N. Robinson, 6th Floor Central Records
Oklahoma City, Oklahoma 73102
Telephone Number: 405-702-6145

There is also a Site Repository at EPA's Dallas Office located at:

EPA Region 6
1445 Ross Avenue
Dallas, TX, 75202-2733
214-665-6427 (Please call for an appointment if you would like to review the file)

11.0 SCOPE AND ROLE OF OPERABLE UNITS AND RESPONSE ACTION

The NCP, 40 CFR Section 300.5, defines an operable unit as a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site.

Due to the complex nature of contamination associated with the Tar Creek Site, remediation has been handled through various removal response actions and remedial actions. The following five operable units (OUs) have been designated at the Site: OU1 - surface water/ground water; OU2 – residential areas; OU3 - Eagle-Picher Office Complex (abandoned mining chemicals); OU4 - Mine and Mill Waste, and Smelter Waste and, OU5 - Sediments. A ROD was signed for OU1 in 1984 that applied to the surface water degradation of Tar Creek and the threat of contamination to the drinking water. This remedy is in an after-action monitoring phase. The ROD for OU2 was signed in 1997 and has applied to lead-contaminated soils at over 2,295 properties. OU3 was a removal action that requires no further action, and OU5 is currently in the early site characterization phase.

The remedial action addressed in this ROD, referred to as OU4, will address the parts of the Site (both urban and rural) that are not currently used for residential purposes (except for the target relocation areas discussed later in the paragraph) or which are sparsely used for residential purposes, where mine and mill

wastes and smelter waste have been deposited, stored, disposed of, placed, or otherwise come to be located. Areas where such material has come to be located will include without limitation chat covered haul roads and non-operating railroad grades. OU4 will also address areas where mine and mill wastes and smelter wastes have been moved by anthropogenic activities (*e.g.,* where chat has been used as a driveway in a rural area) or by natural actions including erosion (*e.g.,* where chat has washed from a chat pile into a stream). OU4 occupies approximately 40 square miles in the northern portion of Ottawa County, Oklahoma, and is generally depicted in Figure 1. OU4 will also provide relocation for residences and businesses in targeted areas including Picher, Cardin and Hockerville. The targeted relocation area is generally described in Figure 9. OU4 will generally not address sediment, except where sediment is incidentally addressed when chat is removed from in-stream or near-stream areas. OU4 will not address ground water or surface water, except indirectly by eliminating some of the sources of ground water and surface water contamination. OU4 will also generally not address contamination in streams that is due to mine drainage. OU4 includes residential yards located in Ottawa County outside of city or town limits except for those residential yards that have been addressed under OU2. OU4 includes all suitable areas in very close proximity to the contamination necessary for implementation of the response action. OU4 also includes Site areas selected for repositories for the disposal of source materials and contaminated soils and sediments.

High concentrations of lead are addressed under the selected remedy identified in this ROD; however, the concentrations of lead are not so high as to be several orders of magnitude above levels that allow for unrestricted use and unlimited exposure. Therefore, the lead is not considered to be a principal threat under the NCP; consequently, there is no expectation under the NCP that the lead be treated.

12.0 SITE CHARACTERISTICS

This section of the ROD provides a brief comprehensive overview of the Conceptual Site Model (CSM), a site overview, a description of surface and subsurface features, sampling strategies used in the RI, known or suspected sources of contamination, types of OU4 contamination, location of contamination and known or potential routes of migration, and the geology and hydrology at the Site. Detailed information about the Site's characteristics can be found in the RI Report (AATA 2005b).

12.1 Conceptual Site Model

The CSM for the Site identifies the sources of contamination, release mechanisms, pathways for contaminant transport, the exposure route for contamination, and potential receptors. Figure 4 is a representation of Site contaminant location and movement and potential routes of contaminant migration.

Human Health CSM
The CSM developed in the Baseline Human Health Risk Assessment (BHHRA) is presented in Figure 5. The human health CSM is based on the following exposure pathways: dermal contact with or ingestion of Source Material; dermal contact with or ingestion of surface soils; inhalation of dusts; ingestion of plant tissue, fish tissue, animal tissue, or milk; and ingestion of shallow well water.

Receptors evaluated include residents and recreators (*e.g.*, those who play on chat piles). The exposure pathways are discussed further in Section 14.1.

Ecological Health CSM
The CSM developed in the Ecological Risk Assessment is presented in Figure 6. The ecological CSM includes exposure of receptors to contaminants via direct contact, ingestion, inhalation and dietary transfer. Receptors evaluated include mammalian and avian receptors, plants and the soil community. The exposure pathways are discussed further in Section 14.2.

12.2 Site Overview

The Site is a former lead and zinc mining area with the last known activities occurring in the 1970's. Since the cessation of mining activities, the abandoned mines have filled with ground water from the Boone Formation and most surficial equipment associated with mining and milling activities has been removed.

Early mining operations in the district were characterized by many local miners, each operating on 20- to 40-acre tracts of land. Each mine holding usually had its own mill. It has been estimated that in 1918 there were 230 mills built or under construction at the Site.

In the 1920s, consolidation of milling began with one mill processing ore from several miners. By the l930s, central mills were established, the largest being the Eagle-Picher Central Mill located between Cardin and Commerce, Oklahoma. Many miners ceased their own milling operations in favor of selling their ore production to one of the central mills or having their ore custom milled by these mills. This movement of ore between mines and the central mills resulted in an extensive network of haul roads and rail lines in the district.

12.3 Surface and Subsurface Features

The Site, part of the Tri-State Mining District, is situated within the Osage Plains section of the Central Lowland Province in northeastern Oklahoma. The Osage Plains are generally characterized by a low relief, rolling treeless prairie. The natural topography of the Site has been altered by mining activities. Numerous piles of mine and mill wastes and collapsed structures associated with underground mines are present within the Site (Luza, 1986).

The stratigraphic sequence within the Site consists of Paleozoic carbonate and clastic sedimentary rocks which overlie a Precambrian granitic and igneous basement complex. The surficial formations at the Site consist of Mississippian and Pennsylvanian units having a regional southwestward dip of approximately 20 to 30 feet per mile.

The lower to middle Mississippian Boone Formation is the host rock for the lead and zinc ore deposits in the District. It consists primarily of limestone (sometimes oolitic), dolomite, and chert, along with lesser quantities of sandstone and shale. The principal zinc mineralization present within the ores of the District was zinc sulfide (ZnS), or sphalerite. Lead sulfide (PbS), or galena, was the primary lead mineralization within the ores. These minerals were contained in a matrix consisting of dolomite, limestone, or chert. Most of the zinc and lead mineralization that was the target of mining activities in the District was present within the Boone Formation.

There are two principal aquifers in the region: the Boone (Mississippian) and Roubidoux (Cambro-Ordovician) aquifers. The Boone Formation is the source of the shallow ground water and the Roubidoux Formation is the source of deeper ground water in the area. A sequence of limestone, shale, and dolomite strata, along with the upper portion of the Roubidoux formation forms a semi-confining unit or aquitard separating the Boone aquifer from the Roubidoux aquifer.

Surface waters that drain from the Site flow into two principal regional watersheds: the Neosho River and Spring River basins. Streams that drain the central and western portions of the Site include Tar, Lytle, Quapaw, Garrett and Elm Creeks, and associated tributary drainages. Tar Creek drains the most intensively mined areas of the Site. These streams flow south and drain into the Neosho River, about 1 mile southeast of Miami, Oklahoma. These streams are typically underlain by Pennsylvania shale and as such are subject to rapid runoff, flooding and intermittent flow. Surface drainages in the eastern portion of the Site flow into the Spring River.

Land uses include agriculture, residential, light industry, commercial activities or businesses, and recreational uses, with agriculture being the dominant land use. Approximately 3,700 acres of OU4 has source material on the land surface as shown in Figure 2. Results from field investigations are presented below.

12.4 Sampling Strategy

Major data collection activities focused on source materials (i.e., chat, fine tailings and smelter wastes) and affected media (i.e., affected-soils in the vicinity of source materials, yard soils in rural residences, ground water from rural domestic wells). Pre-existing data was evaluated in the Data Gap Analysis Report (AATA 2004A) in order to utilize the large amount of data already collected at the Site. A sampling strategy was then developed for the remedial investigation to collect sufficient information to characterize the nature and extent of contamination.

High resolution aerial imagery of the Site was acquired in March 2004 to assist project GIS mapping and volumetric calculations of mill residue accumulations. Field investigations were conducted over the period of May to October, 2005.

12.5 Treatability Study

EPA began a review of potential technologies for injecting chat into the mine rooms at the Site in 2004. This review led to the field implementation of a chat injection pilot study at the Montreal Mine. This pilot study included drilling six borings into the flooded mine workings, conducting a sonar survey to evaluate the size of the mine cavern in the vicinity of the borings, and chat injection using a variety of techniques. Approximately 23,700 tons of chat was injected via gravity-feed, water-assisted gravity-feed and reverse augering methods. The mine water was sampled before, during and after the injection to evaluate the impact of the injection on the mine water. An additional 40,000 tons of chat was contained in an innovative trench system that formed the road base for a private ranch road located in a previously contaminated area on the Site. The soils from the trench were used to provide cover for 35 acres of land.

The pilot study was continued at the Tulsa Mine in order to evaluate the injection of fine tailings resulting from the chat washing process. This study included drilling three borings into the mine and injecting approximately 9000 tons of fine tailings.

EPA completed a third chat disposal pilot in September 2005 with the injection of 10,900 tons of chat into the Craig underground mine cavern. This pilot focused on collecting additional information on the movement of metals from the chat into the mine water to evaluate the long-term protectiveness of the technology. The results of the pilots were positive, indicating that this technology should be considered as a remedial component; however, longer-term sampling may be needed to fully understand the chemical fate of the injected materials.

The pilot study approach was refined to evaluate the direct injection of fine tailings from an active chat washing operation. This approach was first evaluated at the Tulsa Mine (Atlas Pile) and later expanded to include LaSalle Mine (Ottawa Pile) and the Swift Mine (Sooner Pile). Each of these areas is included in an on-going long-term monitoring program to assist in understanding the impacts to mine water when fine tailings are injected.

12.6 Known or Suspected Sources of Contamination

The RI confirmed that chat and fine tailings found in piles, bases, chat haul roads, non-operating railroad grades and tailings ponds are significant, high volume sources of contamination that occupy a large area at the Site. Migration of contamination away from these source material areas has impacted surrounding soils and surface water.

12.7 Types of Contamination and Affected Media

Mining and milling operations have resulted in the accumulation of large volumes of chat and fine tailings found in piles, bases, haul roads, non-operating railroad grades and tailings ponds found at various locations throughout OU4 of the Site. These mine and mill wastes contain elevated levels of lead, zinc and cadmium. The media surrounding these accumulations were also evaluated including soils, surface water and ground water.

12.7.1 Chat Piles

Chat is a type of waste tailings produced by the gravity separation milling process once used in the Tri-State Mining District. Chat consists of coarse gravel intermingled with other material such as medium to fine sands, silt and clay. The highest concentrations of lead in chat are generally found in the fine tailings material. A total of 83 chat piles covering a total area of 767.05 acres and with a total volume of 31.32 million cubic yards were identified. Some of these piles are over 100 feet high.

At the surface of undisturbed piles, the fine tailings settle into the chat accumulation and, as a result, the surface of the pile consists predominately of the largest-sized particles. This physical process armors the surface of the pile and limits the exposure and transport of the finer chat particles. In some piles, the chat is cemented, forming a solidified mass that can have nearly vertical faces. This "armored" chat pile surface is readily penetrated by individuals (*e.g.,* recreators) who walk on the piles, and when the surface is penetrated the finer particles are exposed.

A total of 168 chat samples taken one foot below the surface of 20 major chat piles were collected. The samples were ground to pass through a #100-mesh sieve. The concentration of cadmium in the chat ranged from 43.1 milligrams per kilogram (mg/kg) or parts per million (ppm) to 199.0 mg/kg with an average of 94.0 mg/kg. Lead in these samples ranged from 210 mg/kg to 4,980 mg/kg with an average concentration of 1,461 mg/kg. Zinc ranged from 10,200 mg/kg to 40,300 mg/kg with an average concentration of 23,790 mg/kg.

Fourteen chat samples were also taken at depths ranging from zero inches to one inch below the surface at selected chat piles. Only the portion of these samples that would pass through a #60 mesh sieve without grinding was analyzed. This was done to provide the type of data required for the BHHRA. Lead concentrations in these 14 samples ranged from 355 to 1,730 mg/kg; cadmium from 40 to 133 mg/kg; and zinc from 8,990 to 29,900 mg/kg.

12.7.2 Chat Bases

A chat base is an area that was once occupied by a chat pile. Chat bases can be covered with vegetation or are sometimes found bare. There are 243 chat bases identified at the Site, covering a total area of 2,079.26 acres.

Some bases have been cleared thoroughly with just a few inches of chat remaining, while others still contain chat several feet thick in or on a portion of the footprint of the former pile. The average thickness of all chat bases was estimated to be about 2 ft. The total volume of chat remaining in the chat bases at the Site is estimated to be 6.71 million cubic yards.

A total of 22 samples from six chat bases were collected. The samples were ground to pass through a #100-mesh sieve. The concentration of cadmium in the chat bases ranged from 51.0 mg/kg to 151.0 mg/kg with an average of 96.2 mg/kg; lead concentrations ranged from 650 mg/kg to 3,020 mg/kg with an average concentration of 1,863 mg/kg; and zinc concentrations ranged from 9,520 mg/kg to 40,300 mg/kg with an average of 33,600 mg/kg.

12.7.3 Fine Tailings

Two types of fine tailings were identified: 1) fine tailings generated as a waste during washing of chat, and 2) flotation tailings generated during the metal extraction process or milling. A total of 63 tailings ponds covering a total area of 820.47 acres were defined. Based on field drilling and mapping, it was estimated there were 7.21 million cubic yards of washed fine tailings and 1.95 million cubic yards of flotation tailings at the Site.

EPA collected and chemically analyzed 101 samples of fine tailings from chat washing ("washed fines"). EPA also collected and analyzed 55 samples of flotation tailings. The samples were collected from ten major tailings ponds. The samples were composited over their respective depth interval (depth-integrated samples) and were not sieved.

The concentration of cadmium in the washed fine tailings ranged from 10.0 mg/kg to 320.0 mg/kg with an average concentration of 79.7 mg/kg; lead concentrations ranged from 220 mg/kg to 26,600 mg/kg with an average concentration of 3,658 mg/kg; and zinc concentrations ranged from 1,730 mg/kg to 70,000 mg/kg with an average concentration of 15,964 mg/kg.

The concentration of cadmium in the flotation tailings ranged from 26.3 mg/kg to 450.0 mg/kg with an average concentration of 133.0 mg/kg; lead concentrations ranged from 1,130 mg/kg to 17,800 mg/kg with an average concentration of 5,694 mg/kg; and zinc concentrations ranged from 4,690 mg/kg to 103,000 mg/kg with an average concentration of 29,842 mg/kg. With few exceptions, flotation tailings contain higher cadmium, lead, and zinc concentrations than washed fine tailings.

Ten samples of fine tailings were also collected from the Site at depths that were within one inch of the surface of these same fine tailings deposits described in the preceding paragraphs. These samples were sieved using a small mesh size #60 and analyzed as part of EPA's human health risk assessment. Metal concentrations found in these shallow tailings samples were in the same range as those reported from the depth-integrated washed fine tailings samples.

12.7.4 Smelter Wastes

One small lead smelter, the former Ottawa smelter located south of Hockerville, was investigated. It is the only smelter known to have operated on the Site. Though the smelter had a reported processing capacity of 140 tons per day, it did not operate at capacity. The smelter was abandoned and dismantled in the early 1930s.

The primary smelter wastes found on OU4 were slag and clinker. Also present at the smelter area was rubble from the former smelter including brick and concrete blocks, scrap metal, and retort remnants. No flux was identified at this location. The total area containing smelter wastes was estimated to be 2.29 acres. Within these 2.29 acres, smelter wastes occurred as scattered small mounds five to ten feet in diameter and six to fourteen inches in height. The thickness of the smelter wastes was determined by the excavation of test pits. More than 20 test pits were dug within the area determined to contain smelter wastes. The thickness of the waste was found to range from 0 to 14 inches within this mapped area. Field characterization of the smelter wastes indicated that slag made up a majority of the waste material present (75%) with minor amounts of clinker (20%) and rubble (5%).

Five grab samples of smelter wastes were collected. Cadmium and zinc concentrations in the smelter wastes were found to be comparable to those in the source materials at the Site. The concentration of lead in the smelter waste (2,800 to 80,000 mg/kg) was found to be considerably higher than that in the other source materials at the Site. This is consistent with the fact that the former smelter was a lead smelter.

12.7.5 Transition Zone Soils

Transition zone soils are located adjacent to (or underneath) source materials. Transition zone soils have elevated concentrations of chemicals of concern when compared to natural background concentrations. In transition zone soils, the elevated concentrations of chemicals of concern are due primarily to mechanical redistribution of source materials and to a lesser extent, water and wind dispersion.

A total of 360 transition zone soil samples were collected in the vicinity of five isolated mill waste accumulations. Transition zone soil samples at 0 to 1-inch, 6-inch, 12-inch, and 24-inch depths below ground surface (bgs) were collected. Samples from all of these depths were collected at intervals of 0, 5, 10, 20, 40, 70, 120, 200, and 300 feet measured outward from each of the accumulations along selected transects. Evaluation of the laboratory analytical results indicated there is no clear trend in the average concentration of cadmium, lead, or zinc in surface soils relative to distance from mill waste accumulations. However, in some instances, the concentrations of metals appear to decrease with distance and depth. Contamination source material was occasionally encountered in instances where a decrease in metals concentration was not the case.

The observed variation of metals concentrations in transition zone soils is probably caused primarily by the extensive processing, transport, and use of chat throughout the Site. In addition to variations in soil concentrations of contaminants of concern due to the transport and use of chat, anthropogenic activities such as tilling and grading have covered or replaced contaminated materials in some areas. As a result of the tilling and grading, soil concentrations of contaminants of concern in these areas are now generally at or near background concentrations.

For the purpose of the Feasibility Study, EPA estimated the aerial extent and volume of affected soils that contain concentrations of lead that exceed the human health risk-based remediation goal of 500 mg/kg established under the OU2 Record of Decision for Tar Creek Residential Areas. The estimate included the soils within a 50-foot wide transition zone plus soils from historical roads and non-operating railroads. EPA estimated that there are 1,162 acres on OU4 that contain soil lead concentrations that exceed 500 mg/kg. The estimated volume of this contaminated soil is 1,360,000 cubic yards (yd^3). To make this calculation, lead-contaminated transition zone soil was assumed to extend 50 feet beyond the known edge of chat piles, chat bases, and tailings.

12.7.6 Smelter Waste Affected Soils

Smelter waste affected soils are those soils in the immediate vicinity of the former Ottawa smelter located near Hockerville. These soils have elevated concentrations of contaminants of concern when compared to background soils. Thirty-five surface soil samples were collected within one inch of the surface at locations surrounding the former Ottawa lead smelter. Soil lead concentrations were significantly elevated near the former smelter, with concentrations within 200 feet of the former smelter ranging from 1,560 mg/kg to 16,800 mg/kg. Soil lead concentrations decreased to below 500 mg/kg just south of the area affected by smelter wastes and rapidly approached background levels further south. Based on the human health risk-based remediation goal of 500 mg/kg for lead, a 500-foot radius (centered on the former smelter location) and a 6-inch depth of contamination were selected to estimate the aerial extent and volume of smelter waste affected soils. Using these estimates, EPA estimated the area of smelter waste affected soils to be 18.0 acres and EPA estimated the volume of the contaminated soil, with concentrations that exceed 500 mg/kg to be 14,537 yd3.

12.7.7 Rural Residence Yard Soils

As part of the remedial investigation, a total of 77 yards at rural residences were studied. These yards had not been previously investigated. EPA obtained access to 47 of these residences. EPA collected a total of 366 soil samples. Cadmium concentrations in the samples ranged from less than 0.5 mg/kg to 53.8 mg/kg, with an overall average concentration of 4.4 mg/kg. Lead concentrations ranged from less than 0.05 mg/kg to 14,400 mg/kg, with an overall average concentration of 201 mg/kg. Zinc concentrations ranged from less than 1 mg/kg to 10,700 mg/kg, with an overall average concentration of 692 mg/kg. Within an individual residential yard, metal concentrations may vary widely, but to ensure that concentration estimates for soil in a given yard were within statistically significant confidence levels, EPA took composite samples.

Soil lead concentrations exceeded the remediation goal of 500 mg/kg in one or more composite samples at five of the rural residences investigated. EPA took indoor dust samples at four of these five residences where we found elevated soil lead concentrations. The concentration of lead in the house dust ranged from less than the detection limit of the instruments used to 360 mg/kg, with the concentration being below the detection limit at two of the four residences sampled.

Yard soils at the remaining 42 rural residences investigated showed a similar range of metal concentrations as the background soils at the Site. Since, indoor dust lead concentrations correlate to outdoor soil lead concentrations, by remediating the yards, the indoor dust concentrations will be reduced. One of the five residential properties with elevated lead concentrations in yard soils was remediated by EPA in November 2005. EPA expedited the action on this property in response to significantly elevated lead concentrations that were detected on the property.

12.7.8 Ground water

Thirteen rural residences are using ground water from the shallow aquifer for domestic purposes. These private wells were sampled. Two samples, one first flush (a minimum of 8 hours of no flow time) and one flushed (sampled after 3 minutes of continuous flow) were collected from each well. Water from all the wells investigated was neutral to slightly alkaline (pH 7.11 to 7.79) with moderate mineralization (Total Dissolved Solids 160 to 480 milligrams per liter [mg/L]). Eleven of the thirteen wells met the federal health-based standard for lead in drinking water (0.015 mg/L), while concentrations of lead in water drawn from two wells exceeded the standard. No other federal standards were exceeded in any of the wells sampled.

12.7.9 Surface Water

In order to determine whether chat pile seepage was contaminating surface water, the USGS studied flow, water quality, and metal loading from seepage. USGS studied seepage from the Western (John Beaver) chat pile and from the Admiralty chat pile after a rainfall event. Metal loads were calculated from the Admiralty chat pile; however, they could not be calculated at the Western pile due to low flow from the pile during the sampling period.

The USGS report calculated loadings of cadmium, iron, lead and zinc in Tar Creek mine outflow and in leachate from chat piles. The data show that chat leachate accounts for 68% of the cadmium, 1% of the iron, 77% of the dissolved lead and 19% of the zinc in Tar Creek surface water at the study area. The mine outflow accounts for 99% of the iron and 29% of the zinc in Tar Creek surface water at the study area. The majority of the zinc loading (52%) in Tar Creek originates from Lytle Creek. The source of zinc in Lytle Creek was not identified by the study.

EPA concludes from the data described in the preceding paragraph that the chat piles are a significant source of the hazardous substances (cadmium, lead, zinc) in Tar Creek. That is, it is clear that chat pile leachate that follows a rain event is a significant source of cadmium, lead, and zinc in Tar Creek.

12.7.10 Biota

Surface water samples, pond sediment samples, aquatic macrophytes, and benthic macroinvertebrates were collected from three flooded tailings ponds and analyzed. The flooded tailings ponds displayed very low densities of aquatic organisms which may indicate that contamination from OU4 mining and milling waste has caused adverse ecological impacts.

12.7.11 Edible Plants

EPA collected samples of three edible plant species (asparagus, willow, and cattail) in support of the risk assessments. A total of 57 plants were sampled. Four samples were collected from each plant: washed roots, unwashed roots, washed leaves, and unwashed leaves for a total of 228 samples. In addition, a co-located soil sample was collected for each plant. In all three plant types, concentrations of contaminants of concern in roots exceeded stalk (aboveground) concentrations. The maximum cadmium concentration was detected in unwashed cattail root (249 mg/kg). The maximum lead concentration in unwashed roots was highest in cattails (2,759 mg/kg). The maximum zinc concentration was detected in unwashed willow roots at 13,202 mg/kg. The Human Health Risk Assessment found that these levels of zinc and cadmium in edible plants exceeded a hazard index of 1, which is predictive of non-carcinogenic health effects.

12.8 Locations of Contamination and Known or Potential Routes of Migration

As shown in Figure 2, Source Materials are located throughout the Site. The locations of Source Materials are catalogued in an extensive GIS mapping system that was developed using current high-resolution aerial photography which was compared to historic aerial photography and mining maps.

The lateral and vertical extent of contamination was evaluated on select areas as part of the RI to verify the presence of Source Materials and to evaluate the potential for migration of contaminants from these areas. The RI found that contaminants from Source Materials can migrate to surrounding soils and surface waters.

13.0 CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

This section discusses the current and reasonably anticipated future land uses and current and potential beneficial ground and surface water uses at the Site. This information forms the basis for reasonable exposure assessment assumptions and risk characterization conclusions presented in Section 14.

13.1 Current and Potential Future Land Uses

Much of the land at the Site remains undeveloped. Beside the land surface covered by mine and mill residues, land use within the rural areas of OU4 consists primarily of:

- Residential – homes and churches;
- Agricultural- crop farming and pasture grazing;
- Industrial - chat processing plants, asphalt plant, sand and gravel plant, barium plant and fertilizer plant; and
- Commercial –small businesses and retail shops.

Figures 7 and 8 show the land use within OU4. The agriculture classification used in these figures includes areas used to grow row crops and areas used as pastures (grazing land). The agricultural classification is the dominant land use and comprises approximately 17,730 acres (68.3 percent) of the land area ofOU4. Mine and mill residues, and smelter wastes cover approximately 3,670 acres (14.2 percent) of OU4.

There are 232 rural residences identified within OU4 and these occur scattered over the unincorporated portions of the Site. As shown in Figure 8, nearly 75% (170 out of 232) of the rural residences are located in the eastern half of the Site outside of the major mining areas.

Future land uses are not expected to change, and agricultural uses and rural residential uses will remain dominant on the Site. A change is expected for residential and commercial settings in Picher, Cardin and Hockerville which are included in the voluntary relocation. Future land use of the properties that are purchased as part of the voluntary relocation effort being conducted by the LICRAT is stipulated in LICRAT's enabling legislation. A restriction is required for these properties which shall run with the land on the property deed. The restriction will contain a provision that the property may not be occupied by children six years of age and younger until the State formally determines that the area is safe for children of such an age.

Under this ROD, EPA will not take an interest in any real estate as part of the relocation elements of this ROD. Instead, EPA will provide funds to the LICRAT to use for relocation of residents in targeted areas. The State has also agreed that the ODEQ will file a recordable notice of remediation or related action, including an easement, on each property acquired by LICRAT. Pursuant to the State's authority under Oklahoma Statutes 27A § 2-7-123(B) the recordable notice will identify all engineering controls used to ensure the effectiveness of the remediation and will contain prohibitions against engaging in any activities that cause or could cause damage to the remediation or the engineering controls, or recontamination of the soil or groundwater as well as restrictions on land use or other activities that are incompatible with the remedy selected in this ROD.

The Quapaw Tribe adopted a zoning ordinance in 2007 that established planned uses of Quapaw lands. The goal of the zoning ordinance is to preserve all future uses of the land including residential, agricultural, conservation, forestry, industrial and commercial.

13.2 Current and Potential Future Ground Water Uses

Ground water is used as a source of drinking water at the Site, and was addressed under OU1. The deeper Roubidoux aquifer is used by the municipalities as a source of drinking water and the shallow aquifer in the Boone Formation is used as a source of drinking water mainly by rural residents. The wells belonging to rural residents that use the Boone Formation as a source of drinking water were sampled at the tap during

the RI. Use of the Boone Formation as a future ground water source is expected to continue in the rural areas.

14.0 SUMMARY OF SITE RISKS

The BHHRA estimates what human health risks OU4 poses if no action is taken. It provides the basis for taking action at OU4 and it identifies the chemicals of concern (COCs) and exposure pathways that need to be addressed by the remedial action. The BHHRA evaluates the baseline potential risk that might be experienced by human receptors coming into contact with contaminated air, soil, sediment, surface water, ground water, and fish tissue. This section of the ROD summarizes the results of the BHHRA. This BHHRA followed a four step process:

14.1 Summary of Baseline Human Health Risk Assessment

The BHHRA estimates what human health risks the Site poses if no action were taken. It provides the basis for taking action at this Site and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The BHHRA evaluates the baseline potential risk that might be experienced by human receptors coming into contact with contaminated air, soil, sediment, surface water, ground water, and fish tissue. A summary of the risk is discussed below in Section 14.3. This section of the ROD summarizes the results of the BHHRA. This BHHRA followed a four step process:

a. Hazard identification (Identification of COCs),
b. Exposure assessment,
c. Toxicity assessment, and
d. Risk characterization.

14.1.1 Identification of Chemicals of Concern

Table 1 presents the COCs and Exposure Point Concentrations (EPCs) for each of the COCs detected in chat and fine tailings, surface soil, ground water, and plants. The EPC is the average contaminant concentration over the exposure period used to estimate the exposure and risk or hazard from each COC. The COCs were identified following a screening of all of the analytical results from the RI and include lead, cadmium and zinc.

The table also provides the range in concentrations of the COCs detected in each of these media, the frequency of detection (*i.e.*, the number of times the COC in question was detected in the samples collected at the Site), and an explanation as to how the EPC was derived.

14.1.2 Exposure Assessment

Exposure refers to the potential contact of an individual (the receptor) with a contaminant. The exposure assessment evaluates the magnitude, frequency, duration, and route of potential exposure. This section describes which populations may be exposed, the exposure pathways, and the level of exposure to the contaminants present. A complete discussion of all the scenarios and exposure pathways is presented in the BHHRA.

The objective of the exposure assessment is to evaluate potential current and future human exposures to COCs in all media of concern – air, soil sediment, surface water, ground water, and animal tissue. The current and potential future human receptors were determined by the Site's configuration, land and water use, and activity patterns. Receptors were identified for both current and potential future Site conditions.

A complete discussion of all the scenarios and exposure pathways is presented in Section 3 of the BHHRA. As depicted in the Conceptual Site Model (CSM), the following pathways for current and future receptors were considered complete:

• General public child resident – Ingestion of surface soil, ingestion of drinking water, and inhalation of ambient air

• General public adult resident – Ingestion of surface soil, ingestion of drinking water, and inhalation of ambient air
• Native American child resident – Ingestion of surface soil, ingestion of drinking water, inhalation of ambient air, and ingestion of dairy milk
• Native American adult resident – Ingestion of surface soil, ingestion of drinking water, inhalation of ambient air, and ingestion of fish, beef, edible plants, aquatic life (such as mussels, crawfish), and small game animals
• Recreator – Ingestion of surface waste materials (such as material found in chat pile and mill pond material)

Exposure route, receptor, receptor-specific assumptions, and exposure point concentrations are presented in Tables 1 through 4. These exposure routes were evaluated to determine human health risk related to OU4.

14.1.3 Toxicity Assessment

Toxicity assessment is accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical is associated with a particular adverse health effect and involves characterizing the nature and strength of the evidence of causation. The dose-response assessment is the process of predicting a relationship between the dose received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values are derived that can be used to estimate the potential for adverse effects as a function of potential human exposure to the chemical of concern.

For noncancer outcomes, a chronic reference dose (RfD) is derived from the no-observed adverse-effect level (NOAEL) or lowest-observed-adverse-effect level (LOAEL) in animals or humans. RfDs are derived by dividing the NOAEL or LOAEL by an uncertainty factor that represents a combination of various sources of uncertainty associated with the database for that particular chemical. EPA's IRIS database and National Center for Environmental Assessment (NCEA) served as the source of RfDs for the COCs at Tar Creek, except for lead (discussed below), for which there is no IRIS RfD and for which other sources of toxicity data were used.

Dermal RfDs are not available in IRIS, Provisional Peer Reviewed Toxicity Values (PPRTVs), or HEAST. Equations presented in EPA guidance (EPA, 1989) were used to calculate dermal RfDs for cadmium and zinc. An inhalation reference concentration (RfC) was not available for zinc. Note that cadmium also has potential cancer effects and has its own IRIS slope factor (SF) via the inhalation pathway.

Risk assessments for lead differ from those for other noncarcinogens in that they assess the risk of elevations in blood lead levels (BLLs), as elevated BLLs have been directly related to adverse outcomes in adults and children. In studies conducted around the world, elevated BLLs have been found to be associated with a variety of adverse health effects including neurocognitive and impaired behavioral development in young children.

For cancer outcomes, the dose-response information is condensed into a SF, in units of $(mg/kg\text{-}day)^{-1}$, which expresses excess lifetime cancer risk (ELCR) as a function of (lifetime average) daily dose. EPA maintains an online database, IRIS (EPA, 2005d), which contains SFs that are based on the current weight of toxicological evidence. Of the three COCs identified at Tar Creek, only cadmium was evaluated for carcinogenic risk since it was the only identified potential carcinogen.

Tables 5 and 6 show the cancer and the non-cancer toxicity values, respectively, for the COCs that are the major risk contributors at the Site. For complete information on the toxicity of the COCs, see the BHHRA.

14.1.4 Risk Characterization

The risk characterization section of the ROD summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risk at the Site. Baseline risks are those risks and hazards that the Site poses if no action were taken.

Carcinogens
For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated using the following equation:

Risk = CDI x SF

where:

Risk = a unitless probability (e.g., 2 x 10-5) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1.

An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an American individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is $1x10^{-4}$ to $1x10^{-6}$.

Noncarcinogens
The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a RfD derived for a similar exposure period. A RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all contaminants of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI less than 1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where:

CDI = Chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Lead
Risk assessments for lead rely on predicted BLLs in a community, as BLLs have been directly related to adverse outcomes in adults and children. Because vast quantities of lead have been distributed throughout Tar Creek due to historical mining-related activities, the BHHRA devoted substantial effort to characterizing the risks of lead toxicity. The Integrated Exposure Uptake Biokinetic (IEUBK) model was used to estimate risks to children from lead exposure from soil and other media. The EPA's Adult Lead Methodology (ALM) was used to evaluate residential adult and adolescent recreator exposures to lead in soil.

At sites like Tar Creek, EPA policies seek to protect the health of the most vulnerable populations, namely children and women of childbearing age. EPA strives to reduce soil lead levels so that no child or fetus of a woman of childbearing age would have more than a 5 percent chance of exceeding a BLL of 10 µg/dL.

14.1.4.1 Risk Estimations

Potential ELCRs, HIs, and BLLs were calculated using RME assumptions for the general public, Native American residents, and recreators for the exposure pathways. The summaries of these risk estimates are presented in Tables 7 through 9.

14.1.5 Uncertainty Analysis

Some level of uncertainty is introduced into the risk characterization process every time an assumption is made. In regulatory risk assessment, the methodology dictates that assumptions err on the side of overestimating potential exposure and risk. The effect of using numerous assumptions that each overestimated potential exposure provides a conservative estimate of potential risk.

14.1.5.1 Data Evaluation Uncertainty

The purpose of data evaluation is to determine which chemicals are present at the site at concentrations requiring evaluation in the risk assessment. Uncertainty with respect to data evaluation can arise from many sources, such as the quality of the data used to characterize the site and the process used to select data included in the risk assessment. Analytical parameters were selected based upon knowledge of historical site activities (mining). There is some uncertainty associated with the size of the Tar Creek study area and the limited number of samples that were collected from the various media. However, the data are expected to represent the range of concentrations that may be contacted in the various media within the Tar Creek area. Use of this data is not expected to affect the conclusions of the BHHRA significantly, but adds uncertainty to the locations that may warrant risk management.

14.1.5.2 Exposure Assessment Uncertainty

Significant uncertainty exists in assumptions used to calculate chemical intakes from exposure to various media (e.g., rate of ingestion, frequency and duration of exposure, absorption efficiency). Conservative exposure factors (i.e., health-protective) are used when available information is limited. This may result in an overestimation of risk.

There are uncertainties in the modeling used to estimate lead exposures by adolescent recreators. The more significant uncertainties include the use of the ALM for an adolescent population, the potential for a lead higher absorption factor (i.e., up to 30%), the potential for a higher soil ingestion rate (e.g., 200 mg/day), the potential for a lower exposure frequency (e.g., 78 days/year), and a potential lower baseline BLL than that assumed in the risk calculations. However, a potentially higher absorption factor and lower baseline BLL are likely to cancel each other out in the lead exposure calculations.

The bioavailability of lead in soil at the Tar Creek site was not measured. However, the bioavailability of lead in soil was evaluated at the Jasper County, Missouri Superfund Site, a similar site to Tar Creek OU4 in terms of waste sources and environmental conditions. Three soil samples from the site (composites from different areas of the site) were used in a study to measure the gastrointestinal absorption of lead from soil. Concentrations in the three soil samples ranged from 4,050 to 10,800 ppm lead. The amount of lead absorbed by each animal was evaluated by measuring the amount of lead in the blood, liver, kidney, and bone. Results indicate absolute bioavailability in the range of 29 to 40 percent. Therefore, the default absolute bioavailability factor of 30% used in the IEUBK model seems to fall within the range of the actual bioavailability for the site soil and, as such, the assumed bioavailability does not over- or under- estimate site risk.

14.1.5.3 Toxicity Assessment Uncertainty

Dermal toxicity values are not available in the standard toxicity references. Therefore, dermal toxicity values were calculated using oral toxicity values and available oral absorption efficiencies for the study animals for which oral RfDs were derived. Depending on the quality of the data available for absorption efficiencies, and depending on whether or not dermal exposures result in the same type of target effect (as observed in the oral study), this may result in underestimation or overestimation of risk.

14.1.5.4 Risk Characterization Uncertainty

Generally, the goal of a baseline HHRA is to estimate an upper-bound, but reasonable, potential risk. Such an upper-bound estimate can be derived in several ways, depending on how conservative one wants the final estimate. In the baseline HHRA, several upper-bound assumptions and numerous exposure pathways were combined to estimate potential risks.

Most of the assumptions about exposure and toxicity used in the BHHRAs are representative of statistical upper-bounds or even maximums for each parameter. The result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is conservative.

14.2 Summary of Ecological Risk Assessment

In order to determine ecological risk at the Site, a conservative assessment was performed using a two tiered approach: an initial screening level ecological risk assessment and a conservative evaluation using additional plant and fish tissue in combination with information from the scientific literature and from the Baseline Ecological Risk Assessment that EPA developed for a Superfund Site in nearby Cherokee County, Kansas. The overall conclusions regarding the risk drivers for terrestrial soil and plant communities and for terrestrial/riparian mammal and bird communities show high model-calculated risk from exposure to cadmium, lead, selenium, and zinc. Food chain models also frequently, but less often, resulted in high model-calculated risk to these communities from exposure to Site-related copper and nickel. The primary risk drivers (cadmium, lead, and zinc) which had maximum measured concentrations in chat, fine tailings, soil and sediment on-site are high enough to present risk to fauna through incidental ingestion of soil/sediment alone. In addition, there would undoubtedly be some additional fauna exposure via dietary transfer. Dietary transfer is exposure to contaminants through consumption of other animals or plants that accumulated contaminants either through direct exposure or through consumption of other animals or plants that had direct exposure to contaminants. There is also concern regarding the potential risk for exposure of waterfowl to high concentrations of zinc. In several cases for avian receptors (waterfowl), calculated risk was greatest for zinc.

In lieu of conducting a Baseline Ecological Risk Assessment for OU4, the Ecological Remediation Goals developed by EPA for the nearby Cherokee County, Kansas, site (another site with mining and milling related contamination) were considered. The Cherokee County Superfund Site and Tar Creek OU4 Superfund Site are both part of the same Tri-State Mining District (Kansas, Missouri and Oklahoma). The two sites are also in the same ecological sub region and province – the Osage Plains section of the Central Lowland Province. Mining operations at both of these Sites used the ore deposits of the Picher Mining Field for the production of lead and zinc, and were separated only by the political boundary - the Kansas-Oklahoma state line which has no effect on ecosystems. Mining operations of the Picher field ore deposits resulted in cadmium, lead and zinc being the primary risk driver for both sites and the background concentrations of these metals are comparable between both of the Cherokee County Superfund Site and the Tar Creek OU4 Superfund Site. There are other similarities between the sites including climate, topography, flora and fauna which make our use of the Cherokee County site study appropriate.

The remediation goals for soil at the Cherokee County site were developed based on the exposure of terrestrial wildlife to contaminated soil. The pathway that frequently drives ecological risk assessments at mining sites is the intake of soil by ground feeding insectivores, also known as vermivores. Vermivores are sensitive species for two reasons. First, there is a relatively higher percentage of soil (hence metals) in their diets. Second, the soil invertebrates the vermivores consume have a relatively higher metal concentration in their tissue compared to food sources uses by other species. Generally, there are two species that represent vermivores well, and they are the short-tailed shrew (class mammalia) and the American woodcock (class aves). Remediation goals that are protective for vermivores should also be protective of other less sensitive guilds of terrestrial wildlife.

The Cherokee County analysis recommended a range of values for cadmium, lead and zinc in soil that would be protective for exposed terrestrial wildlife. The recommended soil preliminary remediation goals were given as a range:

Cadmium	1.0 – 10.0 mg/kg
Lead	377 – 1175 mg/kg
Zinc	156 – 1076 mg/kg

EPA used this analysis in its selection of the remediation goal for the Cherokee County, Kansas, site in the Amended Record of Decision for that site dated September 29, 2006. The specific levels selected for the Cherokee County site were 10.0 mg/kg cadmium, 400 mg/kg lead and 1100 mg/kg zinc. Based on similarities between Cherokee County and the Tar Creek Site, EPA has selected 10.0 mg/kg cadmium, 500 mg/kg lead and 1100 mg/kg zinc as the soil Remediation Goals to address ecological risks at the Site. The remediation goal for lead is higher at the Tar Creek Site than Cherokee County; however, it is still on the lower end of the range recommended in the Cherokee County analysis. The remediation goal of 500 mg/kg lead was selected in order to be consistent with the remediation goal established in the OU2 ROD for Tar Creek Residential Areas for the protection of human health. EPA selected 400 mg/kg at the lower end of the range for lead developed at the Cherokee County site due to concerns regarding future sediment recontamination. However, EPA proposes to implement erosion controls to limit future sediment transport at Tar Creek, and therefore, has selected 500 mg/kg. This 500 mg/kg soil lead remediation goal is also applicable to Source Material at the Tar Creek Site. Source material, including chat, fine tailings and smelter wastes, is a source of contamination to the soil at the Site.

14.3 Basis for Remedial Action

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

Human Health Risk

The primary human exposure at OU4 occurs through incidental ingestion associated with normal hand to mouth contact after contact with soil and source materials. Contaminated water drawn from certain rural domestic wells also poses a risk. Exposure through the ambient air inhalation route of intake poses no health risk. The Baseline Human Health Risk Assessment identified lead as the primary chemical of concern and determined that addressing exposure from lead will also be protective for cadmium and zinc exposures.

Risk to Children Living in Residences with Lead Contaminated Yards

EPA has various tools that it can use to evaluate risk posed by lead, but, after considering various other methods, EPA decided to use, at OU4, the Integrated Exposure Uptake Biokinetic (IEUBK) lead model as a risk assessment tool to evaluate potential health risk to young children from exposure to lead in the various media (e.g., indoor dust, tap water, and air) and especially in soil. Based on the IEUBK modeling, 5 out of 47 residences sampled had lead concentrations in yard soil that posed risk to young children that exceeded acceptable levels. EPA attempts to reduce exposure to lead such that a typical child (or a hypothetical child) or group of similarly exposed children have a risk of no more than 5 % of exceeding a blood lead level of 10 micrograms per deciliter (µg/dL).

Risk to Site Residents Who Live by Eating OU4 Plants and Animals

On OU4, EPA found that lifestyles that involve ingestion of plants grown near source areas or ingestion of meat or dairy products from animals feeding near source areas, will increase exposure to chemicals of concern in soils, and will also increase human health risk. These subsistence activities may pose a health risk even in locations where there are concentrations of contaminants that would generally be seen as posing minimal risk to the general public.

Risk to Residents Who Consume Water Drawn From Contaminated Ground Water

At OU4, two out of thirteen private wells sampled had lead concentrations that exceed the standards established in the National Primary Drinking Water Regulations. Since the shallow aquifer is contaminated,

EPA proposes to protect residents using private wells for drinking water by providing alternative water supplies if concentrations of lead in well water exceed the National Primary Drinking Water Standard of 0.015 mg/L for lead.

Risk to Residents Who Have Recreational Contact with Source Material

At OU4, areas contaminated with source material are subject to frequent recreational use by adolescents. To determine the risk to these adolescents, EPA considered using various methods, but decided that using the Adult Lead Methodology (ALM) was the most appropriate method. Using the ALM, the Baseline Human Health Risk Assessment predicts that 22.3% of adolescents who play in source areas about 184 days per year (the average number of days without rain and above freezing) will have blood lead levels that exceed 10 µg/dL. The female adolescent population may be considered sensitive since exposures during adolescent years may result in a body burden of lead that is available to transfer to the fetus later in life. Protecting the sensitive subpopulation will also be protective for adolescent/adult males.

Addressing Human Health Risk

EPA's remediation goal for lead in source materials

EPA attempts to select a remediation goal for adults that will ensure that a fetus of a woman of childbearing age will have no greater than a 5% chance of having a blood lead level greater than 10µg/dL. To develop the Remediation Goal for lead in source material that is protective for an adolescent recreator, the adult lead model (ALM) was adopted as recommended by the Technical Review Workgroup for metals and asbestos (TRW) . During the Feasibility Study, Preliminary Remediation Goals (PRGs) for adolescent recreators were evaluated based on various possible exposure assumptions (model parameters) presented in chapter 8 of the Baseline Human Health Risk Assessment (BHHRA). The estimated PRGs ranged between 350 milligrams of lead per kilogram of soil (mg/kg) and 1,095 mg/kg., with more typical PRGs ranging between 547 mg/kg and 620 mg/kg. However, due to the fact that some chat piles are close to rural residential areas, there is a potential for younger children to play on them and to become exposed to lead through incidental ingestion of contaminated source material. In addition, adolescents playing on the chat will likely come in contact with unvegetated fine tailings at a higher rate than they would on sod-covered contaminated soil (the model is based on soil), and, therefore, the adolescents playing on the chat piles are expected to have a lead ingestion rate that ranges toward the higher end of the ingestion rates contemplated in the adult lead model. Due to these reasons, a more conservative remediation goal of 500 mg/kg (the same cleanup level used for the residential areas is OU2) was selected as the Remediation Goal for lead in source material under this ROD. The ALM predicts that this 500-ppm remediation goal for lead in source materials will protect adolescents who use these areas for recreation, because it provides protection to the more sensitive future fetuses of female adolescents who use these areas for recreation. Specifically, the goal is to reduce the central estimate of blood lead concentration in adults that are exposed to source materials, to a level that ensures that the predicted 95th percentile fetal blood lead concentration of their offspring does not exceed 10µg/dL. As explained further in the 1997 EPA ROD for OU2 Tar Creek Residential Areas, the 500 ppm will also be protective for younger children in the event they come in direct contact with source material.

Increased exposures are also associated with subsistence lifestyles that increase contact with impacted soil and that increase ingestion of biota (plants or animals) that may have accumulated lead or chemicals of concern. The Quapaw Tribe has identified subsistence activities that its members undertake on the Site, and these activities are of the sort that increases ingestion of contaminated biota. The selected remedy identified in this ROD should provide protection for the subsistence lifestyle at the conclusion of the remedy. The removal of source materials, transition zone soils, and soils which underlie source material above the action levels and the implementation of soil rebuilding and grading will result in levels of COCs well below the action level and may even achieve background concentrations in some settings.

The potential hazards for residents are dependent on their proximity to chat piles, chat bases, tailings ponds, or smelter waste where elevated concentrations of lead and chemicals of concern have been identified, and upon their activities in these areas. The more likely it is that a resident will encounter contaminated

materials; the more likely it is that the resident may face a health risk. Generally, those living closer to the source materials, especially adolescents, will face a greater risk because they are more likely to use areas contaminated with source material for recreation or as sources of gravel or sand for construction. At residential properties that were not remediated thus far, the public may be exposed directly through contacting contaminated soil. In the proposed plan, EPA addressed the human health risk through removal of chat over 20 years. In this ROD, EPA addresses human health risk through relocation which allows 30 years for chat removal in a way that is cost effective.

Ecological Risk

The ecological risk assessment identified the potential for unacceptable risk to terrestrial receptors on the Site. The primary risk drivers (cadmium, lead, and zinc) were found in chat, fine tailings, and soil on-site in concentrations that are several orders of magnitude above their respective Remediation Goals.

15.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of medium-specific or location-specific goals for protecting human health and the environment. This section presents the RAOs and the remediation goals for source material, soil, and ground water at the Site. It outlines the risks identified in Section 14 and provides the basis for evaluating the cleanup options presented in Section 16. The RAOs also serve to facilitate the five-year review determination of protectiveness of human health and the environment.

15.1 Remedial Action Objectives for the Site

Medium	Summary of Remedial Action Objectives	Remediation Goals
Source Material, transition zone soil, and soil which underlies source material	Prevent adolescents from coming in direct contact, through the ingestion and inhalation exposure pathways, with lead-contaminated source material where lead concentrations exceed 500 ppm. The purpose of this objective is to reduce the central estimate of blood lead concentration in adults (*i.e.*, the mature adolescents in question) that have been exposed to source materials to a level that ensures that the 95th percentile fetal blood lead concentration in their offspring does not exceed 10 µg/dl. This objective will also be protective for children who live on-site in the event they come in direct contact with the source material through the ingestion and inhalation exposure pathways. Prevent terrestrial fauna from coming in direct or indirect contact, through the ingestion exposure pathway, with cadmium-, lead-, or zinc-contaminated source materials and soils where cadmium, lead, and zinc concentrations exceed their respective remediation goals of 10.0 mg/kg, 500 mg/kg, and 1100 mg/kg. By indirect contact EPA means contact with these contaminants via ingestion of plants grown in contaminated source materials and soil. General Tactics: To meet the above remedial action objectives for source material, the remedy selected in this ROD calls for excavation of source materials to native soils with confirmation samples to ensure the remediation goals are met. The selected remedy	<u>Adolescents:</u> 500 ppm lead in source material in transition zone soil, and in the soil which underlies source material. <u>Terrestrial Fauna:</u> 10.0 mg/kg cadmium, 500 mg/kg lead and 1100 mg/kg zinc in source material, smelter waste, in transition zone soil, and in the soil which underlies source material.

Medium	Summary of Remedial Action Objectives	Remediation Goals
	calls for a minimal footprint of source material and maximum unrestricted use of Site land.	
Source Material, transition zone soil, and soil which underlies source material	Prevent riparian biota including waterfowl from coming into contact, through the ingestion exposure pathway, with unacceptable concentrations of lead, cadmium, and zinc in surface water and sediment by eliminating all discharge of cadmium, lead, and zinc from source materials to surface water.	Zero discharge of cadmium, lead, zinc from source materials to surface water. [By zero discharge EPA means discharge concentration levels that would be consistent with the concentration levels that would be expected from soil that has background concentrations of these chemicals.]
Soils	Prevent children from direct contact, through the ingestion and inhalation exposure, with lead-contaminated soil where soil lead concentrations exceed 500 ppm. [The purpose of this objective is to limit exposure to soil lead levels such that a typical (a hypothetical) child or group of similarly exposed children living on site would have an estimated risk of no more than 5% exceeding 10 µg/dL blood lead level.] General Tactics: To meet the above remedial action objective, the remedy selected in this ROD calls for excavation of residential yard soil up to a maximum depth of 12 inches or until soil concentrations no longer equal or exceed 500 ppm, whichever calls for less soil to be excavated. Prevent terrestrial fauna from coming in direct or indirect contact, through the ingestion exposure pathway, with cadmium-, lead-, or zinc-contaminated soil where cadmium, lead, and zinc concentrations exceed their respective remediation goals of 10.0 mg/kg, 500 mg/kg, and 1100 mg/kg. By indirect contact EPA means contact with these contaminants via ingestion of plants grown in contaminated soil. General Tactics: To meet the above remedial action objective, the remedy selected in this ROD calls for excavation of visible source materials down to native soils with confirmation samples of the soil taken to ensure that remediation goals are met.	<u>Children:</u> 500 ppm lead in soil (See OU2 Record of Decision for Tar Creek Residential Areas) Terrestrial fauna: 10.0 mg/kg cadmium, 500 mg/kg lead and 1100 mg/kg zinc, in transition zone soil, and in soil underlying source material.
Ground water	Prevent Site residents from the ingestion of water from private wells that contains lead in concentrations exceeding the National Primary Drinking Water Standards. General Tactics: To meet the above remedial action objective, the remedy will include an alternative water source for those residences affected.	0.015 mg/L lead at the water tap

15.2 Basis and Rationale for Remedial Action Objectives

The basis for the RAOs for the contaminated Site media is the anticipated long-range future land use for the portions of the Site that includes agricultural and rural residential uses. The implementation of both the State's voluntary buyout and the buyout included in this Record of Decision will reduce the potential for exposure to adolescent recreators; however, the exposure will not be completely controlled. The buyout is voluntary and some residents will likely remain either within the city boundaries or in rural residential settings.

Native American peoples within the Site may be subjected to unacceptable risks through exposure routes that are unique to the Tar Creek Site. Some Native Americans, particularly members of the Quapaw Tribe, still engage in traditional ceremonial, medicinal, subsistence, and artistic practices. Some of these practices may involve foraging for native herbs, foodstuffs, and fibers that grow on source materials, such as chat bases, on affected soils or in Site surface waters. There is concern that, by practicing their traditional lifestyles within the Site, Native Americans may ingest COCs in quantities that result in unacceptable risks. The selected remedy identified in this ROD should provide protection for the subsistence lifestyle at the conclusion of the remedy. The removal of source materials, transition zone soils, and soils which underlie source material above the action levels and the implementation of soil rebuilding and grading will result in levels of COCs well below the action level and may even achieve background concentrations in some settings.

Ecological exposures are not expected to decrease. In fact, ecological exposures may possibly increase due to habitat expansion. Specifically, habitat may expand because of the decreasing human population on the Site, a result of the voluntary relocation. Aquatic biota may be exposed to COCs above risk-based criteria in perennial streams, riparian corridors, and ponds. COCs are generally transported to surface water via two pathways—runoff and seepage from surficial source material deposits and ground water discharge from mined/mineralized portions of the shallow aquifer. COCs are contributed via these pathways under all flow conditions, but the largest loads are contributed during seasonal wet periods and rainfall events. EPA's ROD for OU1 addressed the COC loads to surface water that are contributed by ground water discharges.

Aquatic biota may be exposed to COCs above risk-based criteria due to out-washed source materials that are mobilized during rainfall events and deposited in Site surface water bodies. These out-washed source materials can also inundate streambeds and wetland areas, thereby physically affecting otherwise suitable aquatic habitats.

16.0 DESCRIPTION OF ALTERNATIVES

The final alternatives evaluated in the Feasibility Study relied on a thematic approach to remedial actions to address the large scale of the task of remediating source materials and affected soils within the Tar Creek Site. A thematic approach is based on the concept that all of the source material can not be addressed through one technology or action, but instead different categories or "themes" of source material are defined (e.g. chat piles, chat bases) that may be addressed with different types of actions or technologies. In turn, each of these categories or themes may have multiple technologies that can be used to address the source material.. The themes present at the Site, including the following:

- Chat piles
- Chat bases
- Fine tailings, including both chat-washing fine tailings and floatation tailings
- Smelter wastes
- Transition-zone soils

- Residential yard soils

- Smelter-affected soils

Ten alternatives were evaluated and are described in the Feasibility Study (dated July 2007). After the Feasibility Study screening process, Alternatives 1, 4, 5, and 8 were retained for further consideration and detailed analysis.

Voluntary Relocation

In addition to technological approaches, EPA considered permanent relocation as a remedial alternative as part of the FS. CERCLA Section 101(24), 43 U.S.C. § 9601(24), grants explicit authority to conduct permanent relocations by defining remedial action to include:

> *"…the costs of permanent relocation of residents and businesses and community facilities where the President determines that, alone or in combination with other measures, such relocation is more cost-effective than and environmentally preferable to the transportation, storage, treatment, destruction, or secure disposition off-site of hazardous substances, or may otherwise be necessary to protect the public health…"*

Because permanent relocation is considered a remedial action, it is selected for use at a Superfund site only when it has been evaluated through the NCP remedy selection process and determined to be the best overall remedy for the site.

In June 2004, the State of Oklahoma established a local trust to oversee the relocation of families with children less than seven years of age, from the area surrounding the towns of Picher and Cardin. Fifty-one families were relocated under this program. The mission of this trust was expanded under Oklahoma law (27A O.S. Supp. 2006, sections 2201 et seq.) in 2006 with the commitment by Congress of additional federal funds ($18.9 million according to ODEQ). The trust is now in the process of conducting a voluntary relocation of the highest priority residents and businesses in Picher, Cardin, and Hockerville. The 2004 State funds and the 2006 federal funds were not sufficient to provide relocation for all residences and business in the area that was identified by the trust as eligible for relocation (Figure 9).

In developing the proposed plan for OU4 at the Tar Creek Superfund Site, the EPA considered relocation of residents living in Picher, Cardin, and Hockerville. EPA considered relocation because, in order to maintain protectiveness, the remedial alternatives evaluated in the proposed plan would generally require certain property restrictions that some members of the communities may consider undesirable. These property restrictions may include the barricading of streets for months at time, disconnecting residential utilities for extensive periods, and the use of earthmoving equipment and heavy trucks in residential areas. Additionally, the residents may be impacted by dust from the moving of chat. Permanent relocation might address the inconvenience associated with these activities; however, under the Uniform Relocation Act (URA) and its implementing regulations, permanent relocation would have required considerable time and expense. As part of its OU4 Proposed Plan (July 24, 2007), EPA considered relocation as a possible alternative. Alternative 5 was EPA's relocation alternative under the Proposed Plan, and it was rejected because it was not found to be cost-effective.

On November 8, 2007, the Water Resources Development Act of 2007 (WRDA Public Law 110-114) became law. Section 3135 of WRDA is specific to Ottawa County, Oklahoma and states:

> (e) Consideration of Remedial Action- The Administrator of the Environmental Protection Agency shall consider, without delay, a remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601 et seq.) for the Tar Creek, Oklahoma, National Priorities List site that includes permanent relocation of residents consistent with the program currently being administered by the State of Oklahoma. Such relocation shall not be subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4601 et seq.).

(f) Estimating Costs- In estimating and comparing the cost of a remedial alternative for the Tar Creek Oklahoma, National Priorities List site that includes the permanent relocation of residents, the Administrator shall not include the cost of compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4601 et seq.).

WRDA eliminates the constraints of the Uniform Relocation Act, enabling EPA to undertake or fund relocation much more efficiently. As it prepared this ROD, EPA reconsidered relocation in light of this development, based on the most recent information available from the LICRA Trust. As explained below in Section 20.3, EPA has now determined that relocation is cost-effective and provides the best balance of trade offs among the remedial alternatives considered.

16.1 Description of Remedy Components

Remedial Alternatives 1, 4, and 8 are described below to show other alternatives that were considered as EPA developed the remedy selected in this ROD. The selected remedy is described below as Alternative 5.

16.1.1 Alternative 1 – No Action

Evaluation of "no action" is generally required by the NCP. This alternative prescribed no new remedial actions; however, it did recognize the engineering actions ongoing for OU1 and OU2, pilot demonstrations and treatability studies, actions taken under the Oklahoma Plan for Tar Creek, and private chat use.

Capital Cost: $0
Annual O&M Cost: $0
Present Worth: $0

16.1.2 Alternative 4 - Phased Consolidation, Chat Sales and On-site Disposal

If EPA had selected Alternative 4, it would have been identical to Alternative 5—EPA's selected remedial alternative (described below), except that Alternative 4 would not have included two elements of Alternative 5. These two elements, that were not included in Alternative 4, are as follows: 1) Under Alternative 5, EPA will offer to relocate the residents of Picher, Cardin, and Hockerville on a voluntary basis, and 2) Under Alternative 5, EPA will extend the remedy implementation timeframe from 20 years to 30 years because with relocation there would be less risk of exposure to a new generation of residents.
:

Alternative 4 Summary	Quantity
Chat and chat base material excavated, hauled to an on-site chat processor, and released to that chat processor – Phase 1 + Phase 2	6,159,000 yd^3 7,035,000 yd^3 13,194,000 yd^3
Cover Fine Tailings in Place (with Institutional Controls)	252 acres
Chat and chat base material excavated and hauled to an on-site repository	938,000 yd^3
Chat and chat base material excavated and injected into mine workings	469,000 yd^3
Excavate and Haul Smelter Wastes to on-site repository	1846 yd^3
Rural Residential Yard Soils, and	4 yards
Affected Domestic Well Water	2 households
Integrate Near-stream Source Materials and Control Seepage/Runoff	1,254,000 yd^3
Excavation and Removal of In-Stream Source Material	18,000 yd^3
Volume of Chat Used for Environmentally Acceptable Uses	29,231,000 yd^3

For a more detailed description of the alternative, please see the Feasibility Study

Capital Cost: $290,377,000
Annual O&M Cost: $375,000/year decreasing to $125,000/year
Present Worth: $167,735,000
Estimated Implementation time: 20 years

Volume of source material remaining on-site subject to Institutional Controls: 6,314,846*yd*^{3} *that cover 322 acres*

16.1.3 Alternative 5 - Voluntary Relocation, Phased Consolidation, Chat Sales and On-site Disposal

Alternative 5 is EPA's selected remedy under this ROD.

Relocation

Under Alternative 5—the selected remedy, EPA will provide funding to LICRAT to enable LICRAT to relocate those residents of Picher, Cardin, and Hockerville that remain after LICRAT has exhausted other sources of funding. Relocation will be voluntary because EPA understands that some residents may wish to remain in their homes for a period of time. These residents will be advised of the circumstances EPA anticipates after the first 3 years of the relocation. EPA expects that municipal services such as water and sewer service will not be available.

Relocation will mean fewer residents in the Site area, and, consequently, reduced risk of residents being exposed to chat. Therefore, chat piles can remain in place longer (30 years, compared to 20 under Alternative 4), allowing commercial chat sales to occur over a longer period with a greatly reduced risk of exposing residents to any lead contamination from chat. Continued chat sales will contribute to a more cost effective remedy because it will mean that there will be less chat remaining on-site that must be addressed with more expensive remedial alternatives (*i.e.,* remedial alternatives that are more costly than chat sales). Moreover, continued chat sales will mean that less chat will be disposed of on-site. Under Alternative 5—the selected remedy, the methods described below will be used for chat sales and chat disposal.

Chat Sales

EPA is selecting the chat sales program as outlined below as a part of the CERCLA remedy at this site. Consequently, activities undertaken in support of chat sales are undertaken pursuant to CERCLA authority and are part of the CERCLA response action. Chat sales will contribute to a more cost effective CERCLA remedy because it will mean that there will be less chat remaining on-site that must be addressed with more expensive remedial alternatives (*i.e.,* remedial alternatives that are more costly than chat sales). Moreover, continued chat sales will mean that less chat will be disposed of on-site. While EPA does not own any chat and will not purchase any chat, it will provide guidance to chat sales participants as part of EPA's CERCLA remedy.

Under Alternative 5—the selected remedy, the methods described below will be used to ensure that chat/land owners have an opportunity to sell or otherwise plan for the disposal of their chat.

PHASE 1

Source materials will be addressed in a manner that will reduce the overall footprint of contamination and reduce the need for land use restrictions, institutional controls, and operation and maintenance. Phase 1 includes voluntary relocation and chat sales.

- Chat and chat bases from distal areas (generally located outside the high density mining areas and including rural areas as shown in Figure 3), including associated historic chat covered haul roads and railroad grades that are not operating, will be excavated to the underlying native soil. Confirmation samples will be taken following source removal to ensure that the remediation goal is met. The excavated source material from the distal areas will be transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. Following the removal of the source materials in the distal areas, the soils will be rebuilt naturally to sustain vegetation using standard land preparation practices such as ripping, contouring, adding amendments,

disking, fertilizing, planting and seeding. Excavated areas will not be backfilled with a soil cover. In recognition of the potential value of chat, chat/land owners in distal areas will be contacted before any chat is removed from their property. Where these owners agree, chat will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. Where chat/land owners will not release the chat for excavation and disposition, they will be required to provide a plan, including a schedule, for the final disposition of the chat consistent with this ROD. EPA will work with Chat owners to identify alternative chat disposition options.

  - The volume of chat in chat bases and in small chat piles in distal areas is estimated at 3,021,000 yd^3.
  - For cost estimation purposes, it was assumed that all of the chat that is excavated and removed from the distal areas will be hauled to an on-site chat processor and released to that chat processor.

- The EPA acknowledges that chat sales are a pre-existing activity at the Site. To ensure that chat sales continue at the Site and to further promote the environmentally protective use of chat, EPA will facilitate activities to support chat sales (See Section 19.2.2).
- Transition zone soils (soils around and underneath source materials) that exceed the remediation goals will be excavated to a depth no greater than 12" below the final grade established in the remedial design. The final grade will consider land uses and site-wide hydrological impacts. Removed soil may be used for interim cover at the on-site repository. In areas that are excavated, nearby transition zone soils that do not contain concentrations of chemicals that exceed that exceed the remediation goals will be used in the natural soil rebuilding process that is implemented after excavation. The natural soil rebuilding process used to establish the final grade will include standard land practices such as ripping, contouring, adding amendments, disking, fertilizing, planting and seeding.
- Smelter wastes will be excavated and disposed in an on-site repository. Smelter affected soils will be managed in the same manner as transition zone soils.
- Fine tailings will be injected into mine workings or covered in place. The covered fine tailings may be consolidated to reduce the footprint of the final cover. Covering in place will be used for areas that injection is technically impracticable (e.g., adequate mine workings are not in close proximity or physical characteristics of the tailings are not amenable to injection) or when the volume of tailings greatly exceeds the surface area (i.e., very deep ponds). Based on existing site characterization data, and for cost evaluation purposes, EPA has estimated that Central Mill and Central Mill north tailings ponds will be capped in-place (see Figure 11).
- Injection will be implemented in a manner that complies with the underground injection control regulations for a mine backfill well. As part of the process of ensuring such compliance, a site-wide hydrogeologic study will be performed prior to implementation of the injection of fines or chat into the mine workings. The study will address the requirements of the regulations and will examine whether there is hydraulic connectivity between the Picher Field and the Commerce mine working, identify strategic subsurface locations for injection in order to maximize the number of potential injection sites needed to adequately alter the hydrogeology, and evaluate the long-term effectiveness of this method.
- Source material in Tar, Lytle, Elm, or Beaver Creek, or other Site waterways will be addressed on a priority basis through excavation and/or the installation of a flexible membrane liner, as needed as determined by EPA. The purpose of these measures is to eliminate the contaminant loading from in-stream source materials to surface and ground water. As an interim measure, sheet piling, berms, constructed wetlands, or other engineering controls will be installed to control near-stream source materials in order to help prevent contamination from migrating to surface water. Excavated in-stream materials will be returned to their near-stream origin (*e.g.*, chat would be returned to the near-stream chat pile from which it came). Streambeds addressed by excavation of in-stream source materials will have erosion control measures installed (*e.g.,* constructed wetlands, gabion basket wire and rock embankments, or boulders). Where chat/land owners will not release the chat for excavation and disposition, they will be asked to provide a plan, including a schedule, for the final disposition of the chat consistent with this ROD.

- To help eliminate exposure, education and community awareness activities will be conducted throughout the duration of the remedy.
- An alternative water supply will be provided where mining-related contaminants in water drawn from rural residential wells exceed .015 mg/L for lead for rural households. Rural households that are within the area that has been designated for relocation under the State of Oklahoma's relocation program, but which do not elect to participate in the relocation program, would be eligible for an alternative water supply (estimated two residences).
- Rural residential yards, not eligible for the LICRAT relocation program, that are found to have concentrations of soil lead that exceed 500 ppm, will be excavated to a maximum depth of 12 inches, and the area will be backfilled with clean soil, contoured to promote drainage, and revegetated. If contamination remains at excavation depth, before backfilling, an orange warning material would be placed at the bottom of the excavation to alert those conducting future earthmoving activity.
- On-site repositories will be constructed to accept Site source materials for final disposal. The repositories will cover an estimated 28 acres and will be capable of receiving an estimated 1,000,000 yds^3 of source materials, affected soils, and other Site-related materials such as wood, concrete, and miscellaneous debris. The repository design shall incorporate components that include a clay liner, a filter sand bed, a soil cover, and final site grading. Selection of the repository location will consider proximity to existing source material locations, thickness of underlying soil deposits, soil type, depth to ground water, and presence or proximity of floodplains or other surface water features. On-site repositories will be closed when they reach capacity or at completion of the remedial action. Closure will be accomplished by covering the repository with a soil cover, contouring to promote drainage, and revegetating.
- Environmental monitoring will be conducted to test for contamination in ambient and near source air, surface water, ground water, and sediment as needed as determined by EPA during remediation activities.

Realizing it is a time consuming process to work with distal area chat/land owners, Phase 1 is intended to be implemented in the following planned timeframes:

Years 1 through 3: Negotiate with distal area land/chat owners for chat release and assist them in developing their disposition plan, begin remedial design, and complete relocation by LICRAT.

Years 3 through 12: Construct on-site repository, remove smelter waste, remove source material from streams, integrate near stream source material, provide alternative water supply, and remediate rural residential yards.

Years 3 through 17: Address fine tailings and consolidate distal area chat.

Years 1 through 25: Chat sales will be maximized through federal, state, tribal, and private activities.

PHASE 2

Phase 2 addresses source materials that remain after Phase 1 cleanup activities. This may include chat bases, tailings ponds, unmarketable chat piles and bases, and remaining chat from distal area consolidation.

After completion of Phase 1 activities, distal area chat will be consolidated to areas located in the core of the Site (heavily mined area) that are already contaminated and the surface area of the Site contaminated by source material will be reduced by approximately 75%. Consolidation of distal area chat to the core area will also improve the marketability of the chat. Phase 2 activities will be implemented during the last 5 years of the remedy, years 26 through 30, to make the remedy more cost efficient.

- The remedy will be reviewed, at a minimum, every five years since hazardous substances remain on-site with concentrations that exceed concentration levels that allow for unrestricted use and unrestricted exposure. The remedy would be reviewed to ensure protection of human health and

the environment. As part of the five-year review, EPA will evaluate the progress of chat sales. Chat piles and bases remaining after 10 years will be evaluated for commercial viability. This determination will be made using input from the chat/land owners, appropriate Tribal representatives, and the commercial operators.

- Unmarketable chat piles and bases will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or disposed in an on-site repository. Where chat/land owners will not release the unmarketable chat, they will be asked to provide a plan, including a schedule, for its final disposition consistent with this ROD. If EPA finds that the plan or schedule is unacceptable, EPA may take legal action. Scheduled disposition under the owners' plans must be completed within five years. The volume of unmarketable chat piles and bases is estimated at 9,380,000 yd^3.
- Historic haul roads and non-operating railroad grades that are contaminated will be managed the same as chat bases.
- Institutional controls and operation and maintenance activities will be implemented, as needed as determined by EPA, at repositories and at covered fine tailings ponds where the fine tailings were capped in place.
- Environmental monitoring will be conducted, as needed as determined by EPA, to test for contamination in ambient and near source air, surface water, ground water, and sediment during remediation activities.

The following summary describes the methods that would be used to address OU4 contamination under Alternative 5. The chart also provides the approximate volume of material to be addressed by each method, respectively. The remaining volume of source material which appears in italics below the chart is primarily material capped and left in place that will require Institutional Controls.

Alternative 5 Summary	**Quantity**
Voluntary Relocation	569 properties
Chat and chat base material excavated, hauled and released to a chat processor – Phase 1 + Phase 2	6,159,000 yd^3 7,035,000 yd^3 13,194,000 yd^3
Cover Fine Tailings in Place	252 acres
Chat and chat base material excavated and injected into mine workings	469,000 yd^3
Chat and chat base material excavated and hauled to an on-site repository	207,000 yd^3
Excavate and Haul Smelter Wastes to on-site repository,	1846 yd^3
Rural Residential Yard Soils, and	4 yards
Affected Domestic Well Water	2 households
Integrate Near-stream Source Materials and Control Seepage/Runoff	1,254,000 yd^3
Excavation and Removal of In-Stream Source Material	18,000 yd^3
Volume of Chat Used for Environmentally Acceptable Uses	36, 538,000 yd^3

Capital Cost: $332,435,000
O&M Cost: $375,000/year decreasing to $125,000/year.
Present Worth: $167,288,000
Estimated Implementation time: 2 years to complete the Voluntary Relocation once it is fully funded, and 30 years to implement the remaining components.
Volume of source material remaining on-site subject to Institutional Controls: 6,314,846yd^3 that covers 322 acres

16.1.4 Alternative 8 – Chat Sales and Total Source Consolidation

Alternative 8 would have included many of the same elements as Alternative 5 (including chat sales but not relocation); however, urban and near-stream chat piles and bases would be removed and integrated into existing on-site upland chat deposits as an early response instead of installing engineering controls for near-

stream source materials as required under Alternative 5. Under this alternative, all the chat and chat bases would have been excavated down to native soil and the excavated areas would have been reclaimed by deep tilling, amending the soils if necessary to re-establish vegetation, and re-vegetating with Site-adapted plant species.

Alternative 8 would have utilized various elements to include the following:

- All chat sources (piles, bases, etc.) located in urban and near-stream settings would have been excavated, transported to existing upland chat deposits, and consolidated for future processing and removal by commercial processors. Where possible, chat would have been transported and consolidated in existing upland deposits where active chat processing facilities are already in place. Chat processors would have been selected during Remedial Design based on implementability factors and cost factors (e.g., the cost of transportation and the chat processors' capacity). Alternatively, under Alternative 8, chat processing facilities could have been established by commercial chat processors (if they so desired and made the necessary arrangements with chat and property owners) at the new consolidated chat deposits to facilitate future processing and removal.
- After 20 years, all unprocessed chat would have been injected into underground mine workings or disposed in an on-site repository.
- Fine tailings deposits located in urban and near-stream areas would have been excavated and injected into underground mine workings or covered in place and revegetated. Fine tailings deposits located in near-stream areas would be excavated and transported to an existing upland fine tailings deposit that would have been covered in place. For cost estimating purposed, injection was assumed.
- Excavated areas would have been reclaimed similar to actions for chat source materials.
- Upland fine tailings impoundments would have been stabilized or repaired and subsequently covered with a 12-inch soil cover and revegetated to prevent future releases of fine tailings to the surrounding environments.
- Transition zone soils would have been deep tilled to reduce metal concentrations in the upper layers, amended with biosolids or other organic matter, and revegetated with site appropriate plant species. Abandoned chat haul road and chat-contaminated non-operating railroad grades would have been excavated and disposed of in covered upland repositories.
- Smelter wastes would have been consolidated on-site and covered with vegetated soil covers. The covered areas would have been reclaimed with vegetation and protected by institutional controls. Smelter-affected soils would have been deep tilled to reduce metal concentrations in the upper layers, amended with biosolids or other organic matter, and revegetated with site appropriate species.
- Rural residential wells with water that exceeds remediation goals and yards where soil lead concentrations exceed remediation goals would have been addressed in the same manner as they are addressed under Alternative 5.

Under Alternative 8, the Operable Unit 4 remedy would have been reviewed every five years since hazardous substances remain on-site that exceed concentration levels that allow for unrestricted use and unrestricted exposure. The remedy would have been reviewed to ensure protection of human health and the environment. As part of the review, EPA would have evaluated the progress of chat sales at least every five years (same as Alternative 5).

The following summary describes the methods that would have been used to address OU4 contamination under Alternative 8, and the approximate volume of material to be addressed by each method, respectively. The remaining volume of source material which appears in italics below the chart is primarily material capped and left in place that will require Institutional Controls.

Alternative 8 Summary	**Quantity**
Excavate and Consolidate Urban Chat Piles and Urban Chat Bases	12,796,000 yd^3
Excavate and Consolidate Near-Stream Chat Piles and Chat Bases	7,300,000 yd^3
Consolidate Upland Chat and Inject into Mine Workings	4,690,000 yd^3

Excavate and Consolidate Urban Fine Tailings, Inject into Mine Workings	344,000 yd^3
Excavate and Consolidate Near-Stream Fine Tailings, Inject into Mine Workings	1,654,000 yd^3
Stabilize and Cover Upland Fine Tailings and Transported Near Stream Tailings In Place	8,812,000 yd^3
Consolidate and Cover Smelter Wastes	1,846 yd^3
Deep Till Smelter Affected Soils and Abandoned Haul Roads and RR Grades	14 acres
Rural Residential Yard Soils, and	4 yards
Affected Domestic Well Water	2 households
Volume of Chat Used for Environmentally Acceptable Uses	29,231,000 yd^3

Capital Cost: $478,975,000
Annual O&M Cost: $475,000/year decreasing to $225,000/year
Present Worth: $255,909,000
Estimated Implementation time: 20 years
Volume of source material that would have remained on-site subject to Institutional Controls: 11,849,846yd^3 that cover 846 acres

16.2 Common Elements and Distinguishing Features

This section describes common elements and distinguishing features of the alternatives described above in Section 16.1 of this ROD.

16.2.1 Chat Use and Sales

All of the remedial alternatives considered by EPA (except the no further action alternative) under the Proposed Plan, also included provisions for chat sales. These provisions were adopted as part of the remedy selected in this ROD. For more information regarding these provisions for chat sales, see Section 19.2.2 below.

To ensure that Site chat sales continue and that chat is used in a fashion that is protective of human health and the environment, under all of the remedial alternatives considered by EPA (except the no further action alternative) under the Proposed Plan, all Site chat would be managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble. The remedy selected in this ROD includes these Part 278 waste management criteria. This means that EPA is including both the regulations that apply to transportation construction projects and the preamble guidance that applies to non-transportation, non-residential projects as requirements under the selected remedy. In addition, only the uses described in the preamble (including EPA's June 2007 fact sheet; EPA530-F-07-016B) and the transportation construction project uses described in 40 CFR Part 278 will be allowed for Site chat under this ROD. EPA further explains how these criteria apply in Section 19.2.2 below.

16.2.2 Certification, Record Keeping and Reporting

The requirements described below in Section 19.2.2 would have applied under all of the remedial alternatives evaluated.

16.2.3 Watershed-Based Approach

As part of the selected remedy under this ROD, a watershed-based approach will be taken to address the potential effects remedial actions may have on the local watersheds. A baseline hydrology model will be developed as part of the remedial design to reflect the existing land uses in the basin and to reflect any rainfall storage within the source materials. As source materials are removed, the capacity of the soil and proposed land use to absorb rainfall will be evaluated. The model may also be used as a planning and design tool to prepare a comprehensive watershed plan to mitigate any potential runoff increases. Complete details of this approach and possible control and mitigation measures will be formulated during the remedial design.

EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat sales.

16.2.4 Five-Year Reviews

Five-Year Reviews will be required under the selected remedy. Reviews will be required because the area requiring cleanup will not be available for unrestricted reuse. Since no cleanup would be completed under the "no action "alternative, all waste would be left in place and unrestricted reuse would be prohibited. As part of the review, EPA will evaluate the progress of chat sales at least every five years. Chat piles and chat bases that remain and that are unmarketable after 10 years will be identified and evaluated to see if it can be sold profitably. This determination will be made with input from the chat/landowners, appropriate Tribal representatives, and the commercial operators.

16.2.5 Institutional Controls

ICs were a component common to all action alternatives discussed by EPA in its Proposed Plan, and ICs are included in the selected remedy. These controls will be required to aid in the management of the wastes left on-site and to ensure that only appropriate reuse options are implemented. ICs under the selected remedy include deed notices placed on land parcels that are contained in the Site. ICs would notify current and potential future deed holders of the presence of wastes left on-site. In accordance with Oklahoma law (27A O.S. § 2-7-123), deed notices would identify the reason for the notice, the affected property, the remedy, engineering controls, and land and ground water use restrictions. A recordable notice including an easement granting access to the ODEQ for continued remedial response will be filed by the ODEQ. If DOI is the trustee for the property where wastes are covered and left in place, then IC's will be developed in coordination with DOI.

16.2.6 Presumptive Remedies

Under the EPA guidance entitled Presumptive Remedy for Metals-in-Soil Sites (EPA, 1999a), the suggested presumptive remedy, in the appropriate circumstances, for low-level threat metals-in-soil waste is containment in place [see 9355.0-72FS at pp. 2 and E-4]. Based on the circumstances at OU4 (i.e., low-level threat metals in soil waste) and based on National Contingency Plan (NCP), 40 CFR Part 300, criteria, however, EPA decided, in the remedy screening phase, that it is not practicable or appropriate to pursue the presumptive remedy process at this mining site. The primary reasons and circumstances for not pursuing the suggested presumptive remedy at the Site are the low degree of support for containment in place by the parties interested in OU4 (i.e., the State of Oklahoma, the Quapaw Tribe, and the local community), the low effectiveness of containment over such a large area, and the difficulties associated with implementing such a remedy. These issues are further discussed in the Feasibility Study.

16.3 Expected Outcomes of Each Alternative

The "no action" alternative would not have addressed the risks identified in the BHHRA or in the Ecological Risk Assessment. It would have allowed source material to remain on approximately 4220 acres, eliminating the potential for this land to achieve beneficial reuse.

As far as addressing source materials including chat is concerned, Alternatives 4 and 5 would achieve essentially the same outcome; although, it will take Alternative 5 ten years longer to complete source material remediation. Alternatives 4 and 5 would address source material on approximately 4220 acres in order to attain remediation goals. It is estimated that, under alternatives 4 and 5, 322 acres would contain waste in place. Alternative 5 includes institutional controls that will prohibit agricultural and residential use of these 322 acres. Alternative 4 would have had the same prohibitions. Under Alternative 5, the remaining 92% of the 4220 acres will meet remediation goals that will allow these acres to be used as residential areas by the general public. Alternative 4 would have met these same remediation goals in these areas.

Alternative 8 would also have addressed the 4220 acres of Source Material, achieving the same performance standards. However, under Alternative 8, institutional controls would have prohibited agricultural and residential use on 846 acres. This means that under Alternative 8 only 80% of the 4220-acre source material area would have been acceptable for residential use by the general public once the remedial action was complete.

17.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The EPA uses nine NCP criteria to evaluate remedial alternatives for the cleanup of a release or Site. These nine criteria are categorized into three groups: threshold, balancing, and modifying. The threshold criteria must be met in order for an alternative to be eligible for selection. The threshold criteria are overall protection of human health and the environment and compliance with ARARs. The balancing criteria are used to weigh major tradeoffs among alternatives. The five balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness; implementability; and cost. The modifying criteria are state acceptance and community acceptance.

17.1 Overall Protection of Human Health and the Environment

Under the NCP, remedial alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals, *See* 40 CFR § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Overall protection of human health and the environment is a threshold criterion. Each alternative must meet this threshold criterion in order to be eligible for consideration.

Each of the action alternatives (*i.e.,* Alternative 4, 5 and 8) would meet the first evaluation criterion, overall protection of human health and the environment, in that they each eliminate, reduce, or control human and ecological exposures to concentration levels of contaminants which were established as remediation goals. As stated in the preceding paragraph, however, our assessment of overall protection of human health and the environment draws on our assessments of the alternatives under other criteria as well. Under two of these other criteria, Alternative 5 is clearly superior. These other criteria are listed below (enumerated with romanette) with a brief explanation of our assessments of the action alternatives under each criterion respectively:

i) long-term effectiveness and permanence: As fully explained below in Section 17.3 of this ROD, there are uncertainties associated with the use of land disposal for providing long-term protection from residuals. Also, with land disposal there is the potential that the technical components of the alternative, such as a cap, will have to be replaced. So the remedial alternatives that call for the least land disposal should have the greatest long-term effectiveness and permanence (if all other factors are equal). Under Alternatives 4 and 5 there would be the smallest footprint of land disposed source material. Each of the action alternatives use some land disposal including repositories for some consolidated waste, and they also use capping of fine tailings deposits. Nonetheless, since they have the smallest footprint of land disposal, Alternatives 4 and 5 have the greatest long-term effectiveness and permanence over the largest area, compared to the other remedial alternatives evaluated. Alternatives 4 and 5 call for rapid consolidation of chat bases and small chat piles from the distal areas. Alternative 8 would have the largest footprint of all the action alternatives, and, consequently, it would have the least long-term effectiveness and permanence of all the action alternatives considered.

ii) short-term effectiveness, As fully explained below in Section 17.5 of this ROD, Alternative 5 has the greatest short-term effectiveness of all the remedial alternatives evaluated. Under Alternative 5, short-term risks to the community are the least since it is anticipated that the population that is most at risk will be relocated, probably in less than three years. No other alternative would provide this level of protectiveness in the short term. .

iii) compliance with ARARs. As explained below in Section 17.2, all of the action alternatives including Alternative 5, comply with ARARs. Alternative 1, the no action alternative, would not comply with ARARs.

To summarize, all the action alternatives would meet remediation goals and ARARs, but Alternative 5 has superior short-term effectiveness since it provides for relocation of those most at risk. Alternatives 4 and 5 have superior long-term effectiveness and permanence because they would leave the smallest footprint of contained contaminated source materials on-site.

17.2 Compliance with ARARs

Section 121(d) of CERCLA and the NCP §300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA §121(d)(4). ARARs are listed in Table 13. Compliance with ARARs is a threshold criterion which means that alternatives that do not meet ARARs are not eligible for consideration. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

All action alternatives evaluated (*i.e.,* Alternatives 4, 5, and 8) would meet ARARs.

Chemical-Specific ARARs.
Chemical-specific ARARs identified for OU4 are consistently met by all the action alternatives. The chemical-specific ground water ARARs would be met at residents' taps under all the action alternatives, but are not met in the shallow aquifer in affected areas of the Site. Remediation of the shallow aquifer is not part of the scope of OU4.

Action-Specific ARARs.
All of the candidate action alternatives are equally capable of meeting the action-specific ARARs identified for the individual alternatives.

Location-Specific ARARs.
All the candidate action alternatives are equally capable of meeting the location-specific ARARs identified for the individual alternatives.

To Be Considered (TBC).
Pertinent EPA guidance documents that were considered in establishing remediation goals are identified in the administrative record file including the bibliographies of documents in the record (*e.g.,* the risk assessment documents, and the RI and FS reports). All action alternatives meet remediation goals established with advice from these guidance documents.

17.3 Long-Term Effectiveness and Permanence

Under CERCLA, EPA is required to select remedies that utilize permanent solutions to the maximum extent practicable. *See* 42 U.S.C. § 9621(b)(1). In order to compare the remedy alternatives considered for this ROD, long-term effectiveness and permanence of each alternative was viewed along a continuum (*i.e.,* each alternative was viewed as offering a greater or lesser degree of long-term effectiveness and permanence). Alternatives that are more effective in the long-term are more permanent. *See* A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, OSWER 9200.1-23P (July 1999) at p. 3-9. Under the NCP at 40 CFR 300.439(e), factors that shall be considered, as appropriate, in determining the long-term effectiveness and permanence of a remedy include the following romanette-enumerated criteria:

> *i) Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.*

The type of mining waste and mill waste that will be addressed under any of the Alternatives at OU4 is a high volume low-level threat waste and EPA expects to use engineering controls instead of treatment for this type of waste. *See* 40 CFR § 300.430(a)(1)(iii)(B). None of the waste will be treated under any of the remedy alternatives considered. Consequently, this criterion—"*Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities*" was not relevant for remedy selection under this ROD.

> *ii) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.*

Under Alternative 5 and Alternative 4, in Phase I, chat and chat bases from distal areas would be excavated down to native soils, and confirmation samples will be taken to ensure that the remediation goal is met. The removed material will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, or it will be disposed in an on-site repository. Under Alternative 8 chat and chat bases in urban and near-stream areas would be excavated and moved in an upland deposit for future processing. Under Phase II of both Alternative 5 and Alternative 4, chat that is disposed of at EPA discretion would be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, or it will be disposed in an on-site repository. The remaining Phase II chat will be addressed in a similar manner as Phase I but will occur at the later stage of the remedy to maximize active chat sales and to reduce the volume of Source Material in these areas. In terms of the evaluation criterion above, under Alternative 5 and Alternative 4, most of OU4 areas would be free of source material deposits (they will be excavated to native soil), and, consequently, in those areas, there will be no "*uncertainties associated with land disposal for providing long-term protection from residuals."* Further, in terms of the above criterion, under Alternatives 4 and 5 there will be no "*potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system"* in most parts of OU4 since these technical components will not be used in most parts of OU4 (slurry walls and treatment systems will not be used at all), with the major exceptions of repositories and covered fine tailings. Finally, under each of the alternatives, there will be no "*potential exposure pathways and risks posed"* since the remedial action (excavation to native soils) which covers most OU4 areas will not use technical components that may "*need replacement.*" Alternative 8 has a lower long term effectiveness and permanence compared to Alternative 5 and Alternative 4 because Alternative 8 calls for more widespread areas and larger volumes of source materials remaining on the land surface indefinitely, contained by capping. These capped areas, under Alternative 8, face greater "*uncertainties associated with land disposal for providing long-term protection from residuals."* These capped areas under Alternative 8 also face a greater "*potential need to replace technical components of the alternatives,"* specifically, the potential need to replace caps. Finally, there is greater risk that there may be "*potential exposure pathways and risks posed should the remedial action* [*i.e.,* the extensive caps] *need replacement* under the Alternative 8.

As EPA compared the remedy alternatives considered in developing this ROD, long-term effectiveness and permanence of each alternative was viewed along a continuum (*i.e.,* each alternative was viewed as offering a greater or lesser degree of long-term effectiveness and permanence). To illustrate the relative long-term effectiveness and permanence for some of these alternatives, EPA ranked them below, with the alternative having the greatest long-term effectiveness and permanence ranked first and the one with the least long-term effectiveness and permanence ranked last:

RANK

1-Alternative 5 -The Selected Remedy (Voluntary Relocation, Phased Consolidation, and On-site Disposal) and Alternative 4 (Phased Consolidation, and On-site Disposal) - Alternatives 4 and 5 call for consolidation of chat bases and small chat piles from the distal areas. In fact, as explained above, Alternatives 4 and 5 will leave the smallest footprint

and volume of contained contaminant source material of any alternative. This means that, of the alternatives evaluated, Alternatives 4 and 5 have the greatest long term effectiveness and permanence.

2-Alternative 8 (Total Source Consolidation, Stabilization, and Institutional Controls) –This alternative calls for the most source material to be contained on-site; consequently, fewer areas are excavated to native soil and a larger footprint of contained contaminated source material would remain.

3-Alternative 1 - No Action - Under the No Action alternative, source materials remain in place, and, since EPA has documented ecological and human health risk, the no action remedy is not an effective or permanent remedy.

17.4 Reduction in Toxicity, Mobility, and Volume

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.
Reduction in toxicity, mobility and volume through treatment is not relevant to our cost-effectiveness analysis for OU4.

The type of mining waste and mill waste that will be addressed at OU4 is a high volume low-level threat waste and EPA expects to use engineering controls instead of treatment for this type of waste under all the alternatives evaluated. *See* 40 CFR § 300.430(a)(1)(iii)(B). Consequently, this criterion-- reduction in toxicity, mobility and volume through treatment, is not relevant to the evaluation of cost effectiveness. No treatment is involved in any of the evaluated alternatives.

17.5 Short-Term Effectiveness

Under this criterion, the short-term impacts of alternatives shall be assessed considering the following: (i) Short-term risks that might be posed to the community during implementation of an alternative; (2) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; (3) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and (4) Time until protection is achieved.

Here is our analysis of the short-term effectiveness of Alternative 5:
(a) Short-term risks that might be posed to the community during implementation of an alternative;
Under Alternative 5, short-term risks to the community are the least since it is anticipated that most of the population that is most at risk will be relocated, probably in less than three years. No other alternative provides this level of protectiveness in the short term.

(b) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures;
All identified short-term risks to workers can be mitigated through legally required worker health and safety training and protection measures. However, while potential risks to workers during remedial actions are reasonably similar under all the action alternatives, they are expected to be smaller under Alternative 4, followed by Alternatives 5 and 8. Alternative 8 potentially poses greater risk to workers since it is dependent upon more intense and heavy construction methods and approaches. The voluntary relocation component of Alternative 5 would also pose an additional minor risk to workers engaged in demolition of purchased structures that is not prescribed in Alternatives 4 and 8.

(c) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation
Potential environmental impacts will be similar for each of the action alternatives and can be controlled through management approaches and scheduling of activities. One key difference between the remedial alternatives involves the dependence upon covering of materials in place and the required volume of borrow soils. The volume and aerial extent of soil removed from borrow source areas to meet the needs of

the soil cover system is a potential concern in that these soils are often in productive use as agricultural or pasture lands. Alternatives 4 and 5 have the smallest requirement of cover soils at an estimated 1,189,000 yd^3 of cover soil. Alternative 8 has a cover soil requirement estimated at 2,713,000 yd^3, a volume and area requirement that would lead to a greater potential of environmental impacts and an increased management burden to control the potential impacts.

(d) Time until protection is achieved.
Alternative 8 achieves full implementation of the RAOs within a 20-year timeframe. Alternative 4 achieves control of all source materials within a 20-year timeframe but some of the volume is in a controlled setting at a commercial chat processing operation (as opposed to being addressed by an engineering control). This volume, and the area occupied by the volume, is expected to be reduced significantly within approximately 5 years as commercial processing continues, under Alternative 4. Alternative 5 is expected to take 30 years to meet the RAOs The additional time associated with Alternative 5 is associated with the effects of the voluntary relocation and the phased approach of the work. The voluntary relocation component of Alternative 5 is estimated to require less than three years to complete when it is fully funded.

Under Alternative 5 virtually all contaminant source material will be removed from vast distal areas of OU4, as those areas are cleaned up to native soil. This will be accomplished within 15 years. In addition, under Alternative 5, the population that is most at risk will be relocated. No other remedial alternative can compare to Alternative 5 in short term effectiveness.

17.6 Implementability

Under this criterion, the ease or difficulty of implementing the alternatives shall be assessed by considering the enumerated factors in italics that appear below. Following each factor is an analysis of the alternatives that were considered in developing the ROD. Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

(1) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

All alternatives rely upon proven, conventional, and readily implementable technologies and construction techniques for addressing the vast majority of source materials and affected soils. The technical feasibility of injecting source materials into flooded underground mine workings has been demonstrated through pilot studies that have been conducted by EPA. The studies have concluded that the injection of both chat and fine tailings is feasible, with the injection of fines being more efficient. Monitoring of the effectiveness of the remedy will generally entail confirming that remediation goals have been met in soils and Source Materials using standard analytical methods. Ambient air will also be monitored during remediation to ensure that remedial activities do not cause unacceptable releases of particulates.

(2) Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions);.

In the Proposed Plan, EPA said that Alternative 4 would be the most administratively feasible because it requires excavation in a relatively small area (compared to Alternative 8). In the Proposed Plan, EPA said that Alternative 5 would be the least administratively feasible to implement due to the administrative requirements of relocation under the URA; however, with the passage of WRDA coupled with the arrangements that EPA has made with LICRAT, EPA has reevaluated Alternative 5 and determined that it is almost equal to Alternative 4 in implementability. Specifically, WRDA provides that the URA does not apply to EPA's relocation efforts at Tar Creek under Alternative 5, and LICRAT has agreed to undertake EPA relocation with EPA's role generally limited to conducting some oversight. Consequently, while EPA

still views Alternative 4 as the most administratively feasible alternative to implement, EPA views Alternative 5 as almost administratively feasible as Alternative 4. Alternative 8 would have been the most difficult to implement administratively because under Alternative 8 access to vast areas would have had to have been acquired very quickly. In addition, under Alternative 8 there would have been mass removal of material from urban and near-stream settings in a relatively short period. This effort, under Alternative 8 would have required significant cooperation with municipalities, the county, the BIA, land owners, chat owners, and chat processors.

(3) Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies..

In its Proposed Plan, EPA said that Alternative 5 had an increased labor requirement associated with both the administration and implementation of the voluntary relocation component of this remedy; accordingly, EPA said that Alternative 5 was less implementable than Alternative 4 under this criterion. However, with the passage of WRDA coupled with the fact that LICRAT will generally administer the relocation with some EPA oversight, EPA believes that Alternative 5 will be almost as implementable under this subcriterion as Alternative 4. Alternative 5 will certainly be less difficult to implement than Alternative 8 because Alternative 8 would have required extensive resources to undertake the large-scale relocation of source material that it calls for. EPA now believes that the required labor and materials are readily available to implement all the alternatives, but Alternatives 4 and 5 are expected to be the least likely of the alternatives to be affected by availability of materials or labor. With respect to the availability of borrow soils to construct the cover systems, Alternative 4 and 5 each have identical requirements that are less than that of Alternative 8. Alternative 5 has an increased labor requirement associated with the demolition and disposal of the residential and commercial properties purchased through the voluntary relocation. While this labor force is expected to be available, it is an increased requirement of Alternative 5.

17.7 Cost

The types of costs that shall be assessed under this criterion include the following:
(1) Capital costs, including both direct and indirect costs;
(2) Annual operation and maintenance costs; and
(3) Net present value of capital and O&M costs.

The estimated net present worth costs for the alternatives, not including the No Action Alternative, range from $167,288,000 for Alternative 5, to $255,909,000 for Alternative 8. Table 10 contains the detailed breakout of costs for each alternative with respect to the criterion. In the future, if injection of chat and fine tailings is found to be a viable disposal option, the cost of the remedy may change.

17.8 State And Tribal Acceptance

This criterion considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan. The State of Oklahoma, through ODEQ, provided written comments on the Proposed Plan in a letter dated September 28, 2007. ODEQ did not concur with the Preferred Alternative in the Proposed Plan and offered the following major comments:

- Alternative 5 [which includes relocation] is the State's preferred alternative; and
- Implementation of the Off-site Rule could inhibit the sale of chat.

The Quapaw Tribe provided substantial comments in a letter dated October 1, 2007, raising several concerns with the implementation of chat sales. EPA has provided detailed responses to these comments and others in the Responsiveness Summary (*see* ROD Part 3).

17.9 Community Acceptance

The EPA conducted a public meeting on August 28, 2007, to present the Proposed Plan to the public. The EPA presented Alternative 4 as the Preferred Alternative for the Site. Comments received from the

affected community overwhelmingly supported the inclusion of voluntary relocation into the remedy for OU4.

18.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(l)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied. High concentrations of lead are addressed under the selected remedy identified in this ROD; however, the concentrations of lead are not so high as to be several orders of magnitude above levels that allow for unrestricted use and unlimited exposure. Therefore, the lead is not considered to be a principal threat under the NCP; consequently, there is no expectation under the NCP that the lead be treated.

19.0 SELECTED REMEDY

The selected remedy for the Tar Creek OU4 Site is Alternative 5 - Voluntary Relocation, Phased Consolidation, Chat Sales, and On-site Disposal.

19.1 Summary of the Rationale for the Selected Remedy

In consideration of the criteria used to evaluate the alternatives, EPA has selected Alternative 5 as the Selected Remedy, with some minor modifications. [To emphasize the continuity in our remedy selection process, and for convenience, EPA will continue to refer to the remedy selected in this ROD as Alternative 5.] Alternative 5 achieves risk reduction in the shortest time frames through a combination of voluntary relocation and reducing the footprint of contamination in the distal areas.

Based on information currently available, EPA, the lead agency, has determined that the Selected Remedy meets the threshold criteria (40 CFR § 300.430(f)(1)(i)(A)) and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria (40 CFR § 300.430(f)(1)(i)(B)). The EPA expects the Selected Remedy to satisfy the statutory requirements of CERCLA section 121 (b), 42 U.S.C § 9621 (b), that is, the Selected Remedy will:

- Be protective of human health and the environment;
- Comply with ARARs for all media;
- Be cost-effective; and
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies (such as recycling/reuse) to the maximum extent practicable.

Based on public comments received during the public meeting held to present the Proposed Plan and comments received during the public comment period, the public voiced a strong opinion that voluntary relocation be included in the selected remedy.

19.2 Description of the Selected Remedy

Following is a description of each component of the Selected Remedy. Although the EPA does not expect significant changes to this remedy, the remedy may change "somewhat" during the remedial design and construction processes. Any changes to the remedy described in this ROD would be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences, or a ROD Amendment, as appropriate and consistent with the applicable regulations.

19.2.1 Voluntary Relocation

Voluntary relocation will remove a limited populace from areas with concentrated sources of potential exposure. Ultimately, risk will remain as will the exposure pathway for anyone who visits the source materials, until such time as the remedial actions are completed. Members of the community who elect not to participate in the voluntary relocation would remain in the area near sources of potential exposure. Institutional controls shall be placed on the relocation target properties to enhance the protectiveness sought through the voluntary relocation. The State has also agreed that the ODEQ will file a recordable notice of remediation or related action, including an easement on each property acquired by LICRAT. Pursuant to the State's authority under Oklahoma Statutes 27A § 2-7-123(B), the recordable notice will identify all engineering controls used to ensure the effectiveness of the remediation and will contain prohibitions against engaging in any activities that cause or could cause damage to the remediation or the engineering controls, or recontamination of the soil or ground water as well as restrictions on land use or other activities that are incompatible with the remedy selected in this ROD. The State will be the responsible agency for implementation and enforcement of this institutional control. The controls shall be in effect until the State formally determines that the property is safe for reuse. Figure 9 presents the buyout boundary as determined by the LICRA Trust.

The following elements define the voluntary relocation component.

- The remaining properties not addressed under the State buyout program will be addressed under the selected remedy. Both residential and commercial properties are included. The voluntary relocation will include properties built on restricted Indian land. As provided in WRDA, the voluntary relocation will not follow URA regulations.
- The estimated number of properties being considered for the LICRA Trust buyout program is 744, which consists of 678 residential and 66 commercial properties. On the assumption that the State program can address the relocation of approximately 256 residential properties and 19 commercial properties, a total of 422 residential properties and 47 commercial properties remain to be relocated under the ROD (**Oklahoma Office of the Secretary of the Environment, October 3, 2007**). In addition, an estimated 100 residential properties that are located within the LICRAT buyout boundary, but do not meet state buyout criteria, may need to be relocated under Alternative 5.
- Vacant lots will not be part of EPA's remedy for the relocation program. That is, this Selected Remedy will not provide funding to help compensate owners of vacant lots.
- Structures that remain after residents have been relocated will be removed or demolished and disposed by the LICRA Trust.
- The estimated timeframe for completion of the voluntary relocation of the remaining properties is less than three years.
- EPA will not acquire property under this relocation program. The Selected Remedy will fund LICRAT, through ODEQ, and LICRAT will purchase the properties at issue and carry out the relocation effort with minimal EPA oversight.
- Final disposition of the properties will be determined by the LICRAT.

19.2.2 Chat Sales and Environmentally Acceptable Chat Use

Chat sales are hereby selected as a part of the CERCLA remedy. Continued chat sales will contribute to a more cost effective CERCLA remedy because it will mean that there will be less chat remaining on-site that must be addressed with more expensive remedial alternatives (i.e., remedial alternatives that are more costly than chat sales). Moreover, continued chat sales will mean that less chat will be disposed of on-site. The removal of chat through chat sales will reduce exposure risks. In addition, continued chat sales are important to the Quapaw Tribe, the State, and the community. While EPA does not own any chat and will not purchase any chat, it will assist chat sales participants as part of EPA's CERCLA remedy.

The continuation of chat sales is an integral part of the remedy for OU4. EPA recognizes that most private chat/land owners may be able to sell their chat piles; however, due to the complicated ownership pattern, and due to the restrictions on alienation that exist at the chat piles owned by Quapaw Tribe allottees, EPA anticipates that Indian-owned chat sales will be managed pursuant to an agreement between the EPA and

the DOI that will define roles and responsibilities. EPA can address the release of chat in accordance with CERCLA authorities in a manner that will benefit chat/land owners and the environment.

While chat sales have occurred on and off Site for many years, EPA recognizes that chat sales could be impeded by owners' fear of incurring CERCLA liability to the United States or others arising from unanticipated adverse consequences associated with chat sales. To help allay the concerns regarding potential future liability arising from the sale and transport of chat to off-site locations during the Chat Sale Pilot Project, EPA entered into CERCLA administrative settlements with sellers of the St. Joe Pile, providing a covenant not to sue from EPA for sales made in compliance with the terms of the agreement, and providing contribution protection pursuant to CERCLA § 113(f)(2), 42 U.S.C. § 9613(f)(2). These agreements were approved by the U.S. Department of Justice. Although the Agency wishes to make clear that these agreements provide no protection from any liability already incurred on the basis of past acts or current status, the agreements appear to have successfully facilitated chat sales during the Pilot Project, and it is EPA's intention to extend that practice as chat is sold pursuant to the ROD, subject to coordination and approval with the Department of Justice.

To ensure that Site chat sales continue and that chat is used in a manner that is protective of human health and the environment, under all of the remedial alternatives considered by EPA (except the no further action alternative) all Site chat that is used, on-site or off-site, must be managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble.[2] This means that EPA is including both the regulations that apply to transportation construction projects and the preamble guidance that applies to non-transportation, non-residential projects as requirements for the use of Site chat. Under the remedy selected in this ROD, only the uses described in the preamble (including EPA's June 2007 fact sheet; EPA530-F-07-016B) and the transportation construction project uses described in 40 CFR Part 278 will be allowed for Site chat.

Transportation uses of chat
Although the codified sections of the Chat Rule apply only to chat used in federally funded transportation construction projects, under this ROD, the regulations in the Chat Rule would apply to any transportation construction projects using Site chat whether or not the chat is to be used in a transportation construction project that is a federally funded transportation project.

Transportation construction projects, under the Chat Rule, are activities that relate to the construction of roads and highways and include bases, sub bases, road surfaces, bridges, abutments, shoulders, and embankments. They are not related to any residential use. In developing the Chat Rule regulations, EPA evaluated all the transportation construction uses and concluded that chat used in hot, warm, or cold mix asphalt, slurry seals, microsurfacing and in epoxy seals, or other uses of chat that are evaluated on a case-by-case basis will be safe and environmentally protective.

Non-transportation uses of chat
Under this ROD, only certain non-transportation uses of Site chat described in the Chat Rule preamble and the preamble-referenced fact sheet would be allowed. Specifically, under this ROD, Site chat used in non-transportation projects could only be used in cement and concrete non-residential construction projects as described in the preamble, and in applications that encapsulate the chat as a material for manufacturing a safe product or as part of an industrial process (*e.g.,* glass, glass recycling) where all waste byproducts are properly disposed, as described in the June 2007 fact sheet. In addition, non-transportation cement or concrete project material in question must, on a case-by-case basis, pass one of the two evaluation methods described in the Chat Rule preamble guidance. The two evaluation methods concern testing the material using the Synthetic Precipitation Leaching Procedure, or having a State environmental agency or EPA conduct a site specific risk assessment with a public comment period (*see* the preamble to the Chat Rule for more information).

[2] The Chat Rule can be found at 72 Fed. Reg. 39235 (July 18, 2007). It can also be found at http://www.epa.gov/epaoswer/other/mining/chat/.

Record keeping requirements in 40 CFR Part 278 would apply to transportation uses and non-transportation uses

The record keeping requirements of the Chat Rule would apply to both transportation and non-transportation uses of Site chat under this ROD, with one addition. Under EPA's remedy, a party who acquires chat for use must submit a copy of the written certification described in the Chat Rule to both the State and to the EPA Remedial Project Manager (RPM) for OU4.[3] While the Chat Rule requires certification only to the State, EPA's proposed remedy would require certification to the RPM as well. Chat sellers who fall under the regulatory control of Bureau of Indian Affairs (BIA) may elect to submit a copy of the certification required by the BIA to the EPA RPM. EPA intends to hold free on-site seminars explaining the requirements of the Chat Rule as they apply to the Site.

Please note that the use of chat according to the provisions of the remedy would not affect a person's obligation to comply with existing State or Federal materials specifications or other requirements.

Chat that is taken off-site, must be sent only to a facility that complies with the Off-site Rule (40 CFR §300.440). The term "facility" as used here includes locations utilized for transportation projects and non-transportation projects.

Chat washing facilities are covered under the State of Oklahoma's general fugitive air and general non-point source discharge regulations. The State's general permits require that fugitive dusts and runoff be controlled in a fashion so that dusts do not leave the property line or the boundary of the construction activity. These regulations exist and apply independent of this ROD.

NOTE: Although EPA's Proposed Plan described the substantive requirements of the State regulations described in the preceding paragraph as ARARs, that was an inaccurate description. In fact, since chat washing facilities will continue to operate independent of EPA's OU4 remedial actions, the State's general permit provisions and other State, Federal and local regulations apply with the force of law (to the extent that they did prior to the ROD) with respect to all on-Site chat washing facilities under these jurisdictions, respectively. EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat processing operations.

Chat Sales

EPA is selecting the Chat sales program as outlined as part of the remedy for the Tar Creek Superfund Site. Because chat sales are part of the remedy, EPA will facilitate activities to support chat sales that will include the following:

a) The EPA will work with the DOI to facilitate sales of Indian-owned chat.
b) EPA will present a workshop to assist chat/land owners and sellers with chat sales.
c) EPA will provide sample chat sale agreements and site operating plans to chat/land owners and chat processors.
d) EPA will answer questions about the Chat Rule.
e) EPA will provide technical review to any requests for chat use other than chat mixed in asphalt for federal transportation projects.
f) EPA will conduct a risk assessment on chat materials that exceed the SPLP and proposed for use in concrete as specified in the Chat Rule to support the ultimate sale of the chat.
g) EPA will coordinate with DOJ, as outlined above, regarding liability protection for chat/land owners.

As a consequence of EPA's selection of chat sales as a part of the remedy for the Tar Creek Superfund Site, the BIA, with the assistance of other agencies of the DOI, will manage and administer the following (*DOI letter dated September 28, 2007, from Mr. L. Michael Bogert to Regional Administrator Richard E. Greene*):

[3] Certifications should be sent to Tar Creek Remedial Project Manager (6SF-R), U.S. EPA Region 6, 1445 Ross Avenue, Dallas, TX 75202-2733. Faxes may be sent to EPA at 214-665-6660.

a) Perform engineering ownership determinations, cadastral surveys, and appraisals, if needed;
b) Outreach and communication with the Indian owners of restricted chat and land regarding chat sales and surface leasing;
c) Appraisals of the fair market value of restricted chat and surface leases and provision of copies thereof to the Indian chat owners and land owners;
d) Necessary tasks associated with the review and possible approval of chat sales contracts and business site leases,
e) Quantitative analysis of chat removed from Indian-owned restricted chat piles for production verification purposes;
f) Tasks associated with the accounting of funds and distribution of proceeds from the sale of restricted chat to Indian owners;
g) Logistics associated with competitive or negotiated sales of Indian-owned restricted chat;
h) Assistance, as required in negotiations between Indian owners of restricted chat and potential chat purchasers;
i) Coordination of sales and other issues with the relevant offices of Federal, State, and Tribal governments; and
j) Review and enforcement of sellers' compliance with chat sales agreements and volumetric recording of chat sales.

The Proposed Plan estimated cost included activities and costs associated with those activities in the summary of remedial alternatives. EPA has determined since the Proposed Plan was issued that Hazardous Waste Operations and Emergency Response Standards training will not be required at chat processing/handling operations since these activities are already covered under the applicable Mine Safety and Health Administration (MSHA) standards that are already in effect for these businesses.

Since chat sales is part of each action alternative considered, including the selected remedy, the cost associated with activities facilitating chat sales was included in the net present value cost estimates for these alternatives.

Based on current information, the EPA believes commercial chat sales will continue and will address the largest part of the chat. For purposes of defining the remedy, EPA has assessed information from chat processors and others in determining that approximately 95% of the chat will be removed from the site over a 30 year period through commercial sales.

Under the remedy selected in this ROD, all chat in chat piles and chat bases that is not sold will be excavated to the underlying native soil, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. In distal areas, source material including chat piles, chat bases, and historic haul roads and non-operating railroad grades will be excavated down to native soil, removed and managed. EPA has decided that (along with relocation of residents) collection and management of distal area source material, and excavation of in-stream source materials will be given top priority under this ROD. The majority of the removed source material will be released to chat processors. Chat processors who receive chat will be selected based on implementability factors and cost factors (*e.g.,* processor capacity or cost of transportation) that will be assessed in the Remedial Design. Once the chat is removed, the native soils will be rebuilt using standard land practices. Chat located in streams will also be removed and disposed in the same manner as chat in chat piles and chat bases. That is, it will be excavated to the underlying native soil, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. Under Alternative 5, EPA will seek permission for access to private properties and to remove source materials for disposal. Chat/land owners who do not permit EPA to remove their chat will be provided an opportunity to sell or otherwise plan for its disposition within the following limits. Chat/land owners in distal areas (See Figure 3) who do not give EPA permission to remove their chat will be given the opportunity to develop a plan under which they have up to five years to sell or otherwise dispose of their chat. Chat/land owners of chat in streams who do not give EPA permission to remove their chat will

be given the opportunity to develop a plan under which they have up to one year to sell or otherwise dispose of their chat. EPA will work with chat owners to identify alternative chat disposition options.

19.2.3 Watershed-Based Approach

A watershed-based approach will be taken to address the potential effects remedial actions may have on the local watersheds. A baseline hydrology model will be developed as part of the remedial design to reflect the existing land uses in the basin and reflect any rainfall storage within the source materials. As source materials are removed, the capacity of the soil and proposed land use to absorb rainfall will be evaluated. The model may also be used as a planning and design tool to prepare a comprehensive watershed plan to mitigate any potential runoff increases. Complete details of this approach and possible control and mitigation measures will be formulated during the remedial design.

19.2.4 Phase 1 Elements

The following remedy elements will be undertaken in the first part of the remedial action as early response actions. EPA plans that these Phase I elements will be completed in the first fifteen years of the OU4 remedial action[4].

19.2.4.1 Remedial Actions in Distal Areas

Remedial Actions to Address Chat in Distal Areas

Chat found in chat piles, chat bases, mining era haul roads, and non-operating railroad grades in the distal areas of the Site will be addressed early (within the first fifteen years after the completion of the Remedial Design) in the remedial action process. This effort will be undertaken in order to substantially reduce the overall footprint of contamination and to minimize the need for land use restrictions, institutional controls, and operation and maintenance.

A subsequent and additional benefit derived from this action is the potential for water quality improvements. Water quality should improve once the source material is removed from the distal areas because the source material in these distal areas presently pollutes local watersheds. Distal areas of the Site are generally rural and are outside of the high-density mining areas. The distal areas and the source materials present were divided into a Northeast, Southeast, and the Elm Creek Distal Zones. Each of these zones is associated with a local watershed. Figure 3 depicts these three distal zones and the associated watersheds.

Within fifteen years, chat found in distal areas depicted in Figure 3 will be excavated down to native soils. Chat present in chat piles and chat bases in the distal areas is estimated at 6,159,000 yd^3. The excavated chat will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. Components of the on-site repository will be developed during the Remedial Design and will include measures to address infiltration, grading, and closure consistent with the State of Oklahoma non-hazardous industrial waste landfill requirements. The source material at the Site is a non-hazardous industrial waste (NHIW) under the Oklahoma Solid Waste Management Act (*see* 27A O.S. § 2-10-103),[5] therefore, the substantive ODEQ requirements for construction of a NHIW landfill are an applicable requirement for repositories constructed under this ROD on-site in areas that are not contaminated.

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[4] Time periods for the Remedial Action are all measured from the completion of Remedial Design. Remedial Design is expected to take approximately three years. That is, when we say that Phase I should be completed in fifteen years, we mean that it will be completed within fifteen years of the completion of the Remedial Design. If the Remedial Design takes three years, as we anticipate it will, then it will be 18 years from the start of Remedial Design to the completion of the Remedial Action.

[5] Appendix F to Chapter 515 of Title 252 of the ODEQ regulations say that Wastes exempted by the RCRA Bevill waste exclusion in 40 CFR 261.4(b)(7) are non-hazardous industrial waste (NHIW).

Upon excavation of chat, samples of the underlying and adjacent native soils will be collected and analyzed to confirm that the remediation goals were met in these soils.

Owners of chat and/or the land where chat is present in distal areas will be contacted, and where these owners agree, chat will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. If the owners will not release the chat for excavation and disposition, they will be required to provide a plan and schedule for final disposition that is consistent with this ROD**.** Disposition under the owner's EPA-approved plans must be completed within five years (unless the chat is located in streams in which case, owners will have only one year to complete disposition under an EPA-approved plan). EPA will work with chat owners to identify alternative chat disposition options.

In distal areas, soil cover will not be hauled in to backfill the excavated areas once occupied by chat or contaminated soil. Rather, soils at the bottom of the excavated area will be rebuilt naturally to sustain vegetation using standard land preparation practices such as ripping, contouring, adding amendments, disking, fertilizing, planting, and seeding.

Remedial actions to Address Transition Zone Soils in Distal Areas

Transition zone soils (soils around and underneath source materials) that exceed the remediation goals will be excavated to a depth no greater than 12" below the final grade established in the remedial design. The final grade will consider land uses and site-wide hydrological impacts (See 19.2.3 Watershed Based Approach). Removed soil may be used for interim cover at the on-site repository. In areas that are excavated, nearby transition zone soils that do not contain concentrations of chemicals that exceed the remediation goals will be used in the natural soil rebuilding process that is implemented after excavation. The natural soil rebuilding process used to establish the final grade will include standard land practices such as ripping, contouring, adding amendments, disking, fertilizing, planting and seeding.

19.2.4.2 Smelter Waste Remedial Actions

Smelter wastes will be excavated and disposed of in on-site repositories. These repositories will be contoured to promote drainage upon closure, covered with clean soil and revegetated. Smelter-affected soils will be managed in the same manner as transition zone soils as described above in Section 19.2.4.1. Soils underlying excavated areas will be rebuilt naturally as described above under the Distal Area discussion in Section 19.2.4.1.

19.2.4.3 Fine Tailings Remedial Actions

Fine tailings will be injected into mine workings or covered in place. The covered fine tailings may be consolidated to reduce the footprint of the final cover. Due to the large size of the site, the wide range of physical settings that fine tailings are located, and the difference in the sizes of the tailings ponds, it was determined that a single approach would not be sufficient. Injection will be the preference for the fine tailings, however, covering in place will be used for areas that injection is technically impracticable (e.g., adequate mine workings are not in close proximity or physical characteristics of the tailings are not amenable to injection) or when the volume of tailings greatly exceeds the surface area (i.e., very deep ponds). Based on existing site characterization data, and for cost evaluation purposes, EPA has estimated that Central Mill and Central Mill north tailings ponds will be capped in-place (see Figure 11).

Injection will be implemented in a manner that complies with the underground injection control regulations for a mine backfill well. As part of the process of ensuring such compliance, a site-wide hydrogeologic study will be performed prior to implementation of the injection of fines or chat into the mine workings. The study will address the requirements of the regulations and will examine whether there is hydraulic connectivity between the Picher Field and the Commerce mine working, identify strategic subsurface locations for injection in order to maximize the number of potential injection sites needed to adequately alter the hydrogeology, and evaluate the long-term effectiveness of this method. The regulations pertaining to Class V Injection Wells are applicable to this type of injection; consequently, the substantive requirements of these regulations are ARARs for this aspect of the remedial action. Therefore, as part of the remedial action, it must be determined whether the injection will cause the movement of a contaminant to

underground sources of drinking water that would cause a violation of the primary drinking water regulations (40 CFR Part 141). The use of injection prompts the study of ground water. Table 13 provides additional information on compliance with the UIC regulations. Surface water quality will also be monitored to determine if additional measures, like temporary water treatment, are needed.

The cover, where used, shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-19-53(a) or an equivalent alternative as determined by EPA consistent with OAC 252:515-19-53(c). The requirements of OAC 252:515-19-53(a) include a barrier layer that is at least 24 inches of earthen material. The requirements also include the installation of an erosion layer above the barrier layer. The erosion layer is to be at least one foot of soil capable of sustaining plant growth.

For cost estimating purposes, it is assumed that the fine tailing ponds with the largest volume to surface area ratio (*i.e.,* very deep ponds) will be covered in place with a soil cover. Based upon this assumption, an estimated 4,437,000 yd^3 of fine tailings covering an area of 251 acres will be covered in place. Transition zone soils associated with the fine tailing deposits (*i.e.,* soils adjacent to the fine tailings and soils that underlie the fine tailings) will be rebuilt as described in ROD Section 19.2.4.1 (Remedial Actions in the Distal Areas).

19.2.4.4 Remedial Actions Addressing In-stream Source Materials

If Source Materials are found in Site streams such as Tar Creek, Lytle Creek, Elm Creek, or Beaver Creek, they will be excavated to native soil and returned to their near stream origin. A flexible membrane liner may be used in addition to, or instead of, excavation as determined by EPA. The remedial design will consider factors such as bank slope stability problems due to excavating large volumes of material from the stream bed and other hydrological factors in determining the areas for the flexible membrane liner. Removed source materials will be returned to the nearby chat piles, chat bases, or tailings ponds from which it appears that they came, as determined by EPA. Once in-stream fine tailings are returned to their place of origin, these fine tailings will be addressed as provided in Section 19.2.4.3 (Fine Tailings Remedial Actions). Once in-stream chat located outside the distal areas is returned to its place of origin, the owners of this chat may sell it or otherwise dispose of it subject to the limitations described in Section 19.2.5.1 (Remedial Actions Addressing Unmarketable Chat). Once in-stream chat located in the distal areas is returned to its place of origin, it will be addressed as provided in Section 19.2.4.1 (Remedial Actions in Distal Areas). Until relocated source materials are sold or otherwise addressed (*e.g.* addressed under Phase II section 19.2.5.1 (Remedial Actions Addressing Unmarketable Chat)), these source materials will be contained using interim engineered controls to prevent them from migrating to surface water. These engineered controls may include berms, sheet piling, or constructed wetlands. In locations where source materials have been excavated from streambeds, erosion control measures will be installed, and these may include gabion basket wire and rock embankments, boulders, or constructed wetlands. Figure 10 identifies sections along Tar Creek that may require source material removal and engineering controls.

19.2.4.5 Remedial Actions Addressing Rural Residential Wells

Where concentrations of mining-related contaminants in water drawn from rural residential wells exceeds 0.015 milligrams per liter (mg/L) for lead, the remedy will be to provide an alternative water supply. Rural households that are within the area that has been designated for relocation under the State of Oklahoma's relocation program, but which do not elect to participate in the relocation program, would be eligible for an alternative water supply (estimated two residences). Due to the uncertainty of water supply systems that will remain after the relocation, the method for supplying the water will be determined during the Remedial Design. If, as part of the remedial action, eligible households are connected to existing municipal or rural water supplies, the owner/residents of these households would be responsible for payment of continued water service and for household water system repairs. That is, the remedial action will provide the connection to the alternative water supply to eligible households, but it will not pay for water service or for household plumbing repairs or for system repairs.

19.2.4.6 Remedial Actions Addressing Rural Residential Yard Soil

Where rural residential properties that are not participating in the voluntary relocation program are found to have lead concentrations in yard soils that exceed 500 parts per million (ppm), the yard soil will be

excavated. The soil will be excavated to a maximum depth of 12-inches, the area backfilled with clean soil, contoured to promote drainage, and revegetated. If contaminated soils are known to remain beyond the excavation depth, a warning material (typically high-visibility orange construction fencing) will be placed at the bottom of the excavation prior to backfilling. The warning material would serve to alter those conducting future earthmoving activity.

19.2.4.7 Construction of On-site Repositories

On-site repositories will be constructed to accept Site source materials for final disposal. . The repositories will cover an estimated 28 acres and will be capable of receiving an estimated 1,000,000 yd^3 of source materials, affected soils, and other Site-related materials such as wood, concrete, and miscellaneous debris. The liners for on-site repositories that are not built in areas of contamination shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-11-2(b) unless an alternative is approved by EPA consistent with OAC 252:515-11-2(c). The cover shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-19-53(a) or an equivalent alternative as determined by EPA consistent with OAC 252:515-19-53(c). The requirements of OAC 252:515-19-53(a) include a barrier layer that is at least 24 inches of earthen material. The requirements also include the installation of an erosion layer above the barrier layer. The erosion layer is to be at least one foot of soil capable of sustaining plant growth. For cost estimating purposes, a clay liner, filter sand bed, and a soil cover are assumed although the actual construction will be determined in the Remedial Design. Upon closure, repositories will be contoured to promote drainage and revegetated.

19.2.4.8 Five-Year Reviews

The on-going remedy would be reviewed, at a minimum, every five years since hazardous substances remain on-site with concentration levels that do not allow for unrestricted use and unrestricted exposure. The remedy would be reviewed to assess the ability of the remedy to provide for the protection of human health and the environment. As part of the review, EPA will also evaluate the progress of chat sales. Chat piles and chat bases that remain and that are unmarketable will be identified and evaluated for commercial viability. This determination will be made with input from the chat landowners, appropriate Tribal representatives, and the commercial operators. Chat determined to be unmarketable will be addressed by the Phase II remedial actions described below.

19.2.5 Phase 2 Elements

After Phase 1, the following long-term response actions and other measures will occur. The Phase 2 remedial action elements will be conducted in the final five years of the Remedial Action to maximize active chat sales. Until a chat owner is notified (or effectively notified) that EPA intends to excavate the owner's chat pile or chat base as provided in this ROD, EPA expects that chat owners will continue to sell or use their chat subject only to the provisions of Section 19.2.2 (Environmentally Acceptable Chat Use).

19.2.5.1 Remedial Actions Addressing Unmarketable Chat

Within the heavily mined area or core of the Site, a significant volume of chat is unmarketable. This unmarketable chat is typically found in small chat piles, chat bases, non-operating railroad grades, and roadbeds. These small deposits often have chat that has the appropriate composition and quality for use in asphalt mixes or other commercial products. However chat processors cannot profitably use this chat because excavating the chat and hauling it to a processor would add so much to its cost that it could not be sold at a price that can compete in the market. Also, there is not enough chat in these deposits to warrant setting up chat washing equipment at the deposits. Under the selected remedy, owners of unmarketable chat and/or the land on which the unmarketable chat is found will be contacted, and where these owners agree, the chat will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository.

For alternative comparisons and cost estimating, the volume of unmarketable chat was estimated at 9,380,000 yd^3, or 24 percent of all chat for Alternatives 4 and 8, and 2,073,000 yd^3, or 5% of all chat for Alternative 5. For purposes of the cost estimate, "unmarketable chat" includes chat that is taken from a small deposit to a chat processor, even though the chat processor will wash and sell the chat.

If the owners will not release the unmarketable chat for disposition, they will be required to provide, for EPA review and approval, a plan and schedule for final disposition**.** Disposition under the owner's plans must be completed within five years. If EPA finds that the plan or schedule is unacceptable, EPA may take legal action.

Under the selected remedy, soil cover will not be hauled in to backfill areas where unmarketable chat and contaminated transition zone soil has been excavated. Instead, soils will be rebuilt naturally using standard land preparation practices such as ripping, contouring, addition of amendments, disking, fertilizing, planting, and seeding, until the excavated areas can sustain vegetation. In areas that are excavated, nearby transition zone soils that do not contain concentrations of contaminants that exceed the remediation goal, will be used in the natural soil rebuilding process that is implemented after excavation.

For cost estimating purposes, it is assumed that the unmarketable chat will be addressed in the following manner:

- 90 percent, or 1,866,000 yd^3, of the unmarketable chat will be excavated, transported and released to an on-site chat processor or future processing location in a previously contaminated area of the Site where it will be stockpiled until processed. When EPA said above in this ROD that Phase II is anticipated to take approximately five years, we mean that was how long it would take for the unmarketable chat to be managed. Once chat has been released to a commercial chat processor and stockpiled, it may take well beyond ten years for it to be sold. However, EPA has found that chat processors maintain chat in a controlled setting that prohibits the public from coming into contact with the material. State and Federal health, safety and environmental laws apply to these chat processors. The selected remedy under this ROD adds no additional requirements for chat processors in this regard (other than the chat use requirements described in Section 19.2.2); however, EPA will review the protectiveness of this situation as part of our Five-Year Review process. Once commercial chat processing has ended at a given location, if source materials or contaminated soil remain, they will be evaluated as part of the selected remedy. These potential future actions were not included in the cost estimate for the selected remedy but it is anticipated that they will not be significant.[6]
- 10 percent, or 207,000 yd^3, will be excavated and sent to an on-site repository.

In addition to the above assumptions, all chat found in mining era haul roads that were built with chat and all chat found in non-operating railroad grades will be excavated to the underlying native soil, transported and released to an on-site processor or future processing location in a previously contaminated area of the Site, injected into mine workings, or it will be disposed in an on-site repository. The estimated volume of chat from haul roads and railroad grades, 702,000 yd^3, is accounted for in the total estimated volume of unmarketable chat.

19.2.6 Other Planned Actions Common to Both Phases

Under the selected remedy, institutional controls (ICs) and operation and maintenance activities will be implemented at locations where Source Materials are covered in place. Locations where ICs and operation and maintenance activities will be implemented include tailing ponds that are covered and the on-site repositories which would be covered when closure is completed. Other ICs are included in the selected remedy and are detailed in the following summary:

Location/Area IC Applied	**IC Objective**	**IC Instrument**	**Responsible Organization**
Covered Fine Tailings	Restrict future use of the property to protect the integrity of the	Deed Notice and Easement filed pursuant to Oklahoma Statute	ODEQ For property where DOI

[6] *See* EPA's Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, OSWER 9200.1-23P (July 1999) at p. 7-1 ("Feasibility Study cost estimates are expected to provide an accuracy of +50 percent to -30 percent.")

	engineered cover system.	27A § 2-7-123(B)	is the trustee, then ICs will be established in coordination with DOI.
On-site Repositories	Restrict future use of the property to protect the integrity of the engineered containment system.	Deed Notice and Easement filed pursuant to Oklahoma Statute 27A § 2-7-123(B)	ODEQ For property where DOI is the trustee, then ICs will be established in coordination with DOI.
Property Acquired via Voluntary Relocation	Restrict future use of the property to prevent exposure of residential or commercial inhabitants to chemicals above the Final Remediation Goals (Table 12).	Deed Notice and Easement filed pursuant to Oklahoma Statute 27A § 2-7-123(B)	ODEQ The controls shall be in effect until the State determines that the area is safe for reuse.
Shallow Ground Water	Restrict future uses of ground water from the portion of the Boone aquifer (or shallower) for potable or domestic supply that is impacted with site-related contaminants above the Final Remediation Goals (Table 12).	Oklahoma Water Quality Standards Title 785, Chapter 45, Appendix H	ODEQ

In addition to the instruments above, annual public notices will be published in area newspapers explaining that some areas where source materials were removed may pose a risk if covered contaminated materials are unearthed. These notices will tell where additional information may be obtained.

Monitoring of ambient and near-source air, surface water, ground water, or sediment will be completed as appropriate as determined by EPA during remedial action activities. Pilot projects and treatability studies (*e.g.,* the chat sales pilot project) will continue through completion of the Remedial Design. To help eliminate the possibility of potential exposure to Site source materials, community education and awareness activities will be conducted throughout the duration of the remedial actions. These activities will include, but not be limited to, the following:

- Outdoor billboards located near chat piles that have been used in the past for recreation, warning of the dangers associated with playing on chat piles.
- Biannual notices in utility bills warning of the dangers of chat use in residential areas, and warning people to stay off of chat piles.
- In-school programs to warn children to stay off of chat piles.
- Outreach to community churches, and social groups.

19.3 Summary of the Estimated Remedy Costs

The estimated cost for the selected remedy is $167,288,000. A detailed breakdown of the estimated costs is presented in Table11. The cost summary tables are based on the best available information regarding the anticipated scope of the remedial action. Changes in the cost elements are likely to occur as a result of the new information and data collected during the remedial design phase. Major changes may be documented in the form of a memorandum to the Administrative Record file, an Explanation of Significant Differences (ESD), or a ROD amendment. The projected cost is based on an order-of-magnitude engineering cost estimate that is expected to be within +50 or -30 percent of the actual project cost. In the future, if injection of chat and fine tailings is found to be a viable disposal option, the cost of the remedy may change.

19.4 Expected Outcomes of the Selected Remedy

Following are the expected outcomes of the Selected Remedy in terms of resulting land uses, the remedial action objectives (RAOs), the risk reduction achieved as a result of the response action, and the anticipated impact on the local community.

19.4.1 Available Uses of Land

Once the Remedial Action Objectives (RAOs) (including the Remediation Goals) are met on a given piece of Site property, the land in question should be acceptable for use as residential property for the general public, subject to any institutional controls. Institutional controls (ICs) may include restrictions established by the LICRA Trust, and any easements established by ODEQ under Oklahoma Statutes 27A § 2-7-123(B). As explained above, ODEQ will establish such easements in areas under State jurisdiction where source materials are covered on-site. For property where DOI is the trustee, ICs will be developed by EPA in coordination with DOI. EPA estimates that RAOs will be met for the entire site in about 30 years (*i.e.*, 30 years after the completion of the Remedial Design phase); however, discrete areas of the Site will meet RAOS, and be available for residential use (subject to ICs) as the remedy proceeds.

19.4.3 Final Remediation Goals

Table 12 provides the remediation goals for the COCs in soil, Source Material, and in water at the tap.

20.0 STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP §300.430(f)(5)(ii), the EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

20.1 Protection of Human Health and the Environment

The Selected Remedy will be protective of human health and the environment. The remediation goal for lead in soils and source material will meet EPA's goal to reduce exposure to lead such that a typical child (or a hypothetical child) or group of similarly exposed children have a risk of no more than 5 % of exceeding a blood lead level of 10 micrograms per deciliter (µg/dL). In addition, meeting the Remediation Goals for zinc and cadmium will be protective for terrestrial fauna.

There are no short-term threats associated with the Selected Remedy that can not be controlled. In addition, no adverse cross-media impacts are expected from the Selected Remedy.

20.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and the NCP §300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA §121(d)(4).

The selected remedy will comply with all ARARs through the use of standard engineering and waste management techniques as well as through the implementation of a Site-specific Health and Safety Plan. The selected remedy will meet ARARs from Federal and State laws.

A summary of ARARs and "to be considereds" criteria for the selected remedy are presented in Table 13.

20.3 Cost-Effectiveness

The Selected Remedy (Alternative 5) is cost-effective because the remedy's costs are proportional to its overall effectiveness (see 40 CFR §300.430(f)(l)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (*i.e.*, that are protective of human health and the environment and comply with all Federal and any more stringent State ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). The overall effectiveness of each alternative was then compared to each alternative's costs to determine cost-effectiveness. The relationship of the overall effectiveness of Alternative 5 was determined to be proportional to its costs and, consequently, Alternative 5 represents a reasonable value for the money to be spent. As explained below, Alternative 5 is also the least expensive of the action alternatives, comparing present values.

WRDA has helped make Alternative 5 with relocation a cost-effective remedy. Except for the relocation element, Alternative 5 is the same as Alternative 4 which was identified as EPA's preferred alternative in the Proposed Plan. Unlike Alternative 4, Alternative 5 includes voluntary permanent relocation of the remaining residents of Picher, Cardin and Hockerville. With the passage of WRDA, certain cost avoidance can be realized, and this makes Alternative 5 more cost effective than the other alternatives considered. This cost avoidance includes the following:

- **WRDA eliminates URA expenses, saving $42,997,900.**

  WRDA provides that a Tar Creek Superfund Site remedial action that includes permanent relocation is not subject to the URA. This means that the remaining residents and businesses in Picher, Cardin, and Hockerville can be relocated, by LICRAT, as part of the remedial action at a cost of $42,058,100 instead of $85,056,000 as was projected in the Proposed Plan—a difference of $42,997,900.

- **With relocation, certain elements of the remedy can occur later. The time value of these later expenditures results in a $42,505,100 savings.**

  Supported by requests from the State, the Tribe and the community, EPA's goal is to prevent another generation of residents living near the source materials from being exposed; consequently, EPA initially limited the remedial action to a 20-year period. That is, in the Proposed Plan our preferred alternative (which did not include relocation) called for remedial action to be complete in 20 years. Under the selected remedy, however, EPA will be permanently relocating residents who live near the large concentrations of source material; consequently, EPA can extend the remedial action, and allow chat sales to continue for an additional ten years. This ten-year extension means that certain planned activities will take place later in the remedial action, and, when spending happens later, there are savings associated with the increased value of money over time. To demonstrate, it is useful to compare the present value of Alternative 5, not including relocation, to the present value of Alternative 4. (Remember that Alternative 5 without relocation is essentially the same as Alternative 4.) The present value of Alternative 4 is $167,735,000. The present value of Alternative 5 (with relocation expenses removed from the total costs) is $125,230,000. The $42,505,000 difference in present values represents the time value of incurring costs at a later date. In short, Alternative 5 takes the at risk population out of the immediate area which greatly reduces the chances of exposure, and, with the threat of exposure greatly reduced, this means that chat sales, the least expensive acceptable means of source removal, can continue for a longer period, and more expensive remedy elements can be performed later. With later performance of expensive remedy elements, the present value of Alternative 5 is greatly reduced. (For purposes of this analysis, EPA assumes that essentially all residents will accept relocation.)

STEPS IN THE COST EFFECTIVENESS ANALYSIS

A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)), and this is determined in two steps. In **step one**, overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria: long-term effectiveness and permanence; reduction in toxicity, mobility and volume (TMV) through treatment; and short-term effectiveness. In **step two,** overall effectiveness is then compared to cost to determine whether the remedy is cost-effective (*id*.). EPA has taken these two steps for OU4 as described below, and EPA has come to the conclusion that the NCP (40 CFR 300.430(f)(1)(ii)(D)) cost-effectiveness analysis favors Alternative 5 (Voluntary Relocation, Phased Consolidation, and On-site Disposal). Our **two-step cost-effectiveness analysis** appears below:

A. ***Step one: Evaluate Overall Effectiveness under these criteria: a) long-term effectiveness and permanence; b) reduction in toxicity, mobility and volume (TMV) through treatment; and c) short-term effectiveness***

1) Long-term effectiveness and permanence: Alternative 4 and 5 have greater long-term effectiveness and permanence over a larger area compared to the other remedial alternatives evaluated

Under CERCLA, EPA is required to select remedies that utilize permanent solutions to the maximum extent practicable. *See* 42 U.S.C. § 9621(b)(1). In ROD Section 17.3, EPA compared the remedy alternatives considered for this ROD under the long-term effectiveness and permanence criterion. EPA evaluated each alternative along a continuum (*i.e.,* each alternative was viewed as offering a greater or lesser degree of long-term effectiveness and permanence). EPA determined that the remedial alternatives ranked as follows (*see infra* Section 17.3):

RANK

1-Alternative 5 -The Selected Remedy (Voluntary Relocation, Phased Consolidation, and On-site Disposal) and Alternative 4 (Phased Consolidation, and On-site Disposal) - Alternatives 4 and 5 call for rapid consolidation of chat bases and small chat piles from the distal areas. They also call for covering fines in place. As explained above, Alternatives 4 and 5 will leave the smallest footprint of contained contaminant source material of any alternative. Since there are uncertainties associated with the use of land disposal for providing long-term protection from residuals, this means that of the alternatives evaluated, Alternatives 4 and 5 have the greatest long term effectiveness and permanence.

2-Alternative 8 (Total Source Consolidation, Stabilization, and Institutional Controls) – This alternative calls for the most source material to be contained on-site; consequently, fewer areas are excavated to native soil and a larger footprint of contained contaminated source material would remain.

3-Alternative 1 - No Action - Under the No Action alternative, source materials remain in place, and, since EPA has documented ecological and human health risk, the no action remedy is not an effective or permanent remedy.

2) Reduction in toxicity, mobility and volume through treatment is not relevant to our cost-effectiveness analysis for OU4

The type of mining waste and mill waste that will be addressed at OU4 is a high volume low-level threat waste and EPA expects to use engineering controls instead of treatment for this type of waste under all the alternatives evaluated. *See* 40 CFR § 300.430(a)(1)(iii)(B). Consequently, this criterion-- reduction in toxicity, mobility and volume through treatment, is not relevant to the evaluation of cost effectiveness. No treatment is involved in any of the evaluated alternatives.

3) Short-term effectiveness of the remedial alternatives analyzed. Alternative 5 has the greatest short-term effectiveness.

Under this criterion, the short-term impacts of alternatives shall be assessed considering the following: (i) Short-term risks that might be posed to the community during implementation of an alternative; (2) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; (3) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and (4) Time until protection is achieved. EPA undertook this s four-part analysis in ROD Section 17.4, and Alternative 5 clearly had the greatest short term effectiveness, followed by Alternative 8, and Alternative 4. Alternative 1 is not effective in the short term.

Summary: Alternative 5 has the greatest overall effectiveness

Under Alternative 5, EPA anticipates a greater degree of long-term effectiveness, and, therefore, permanence than any of the other remedies (except Alternative 4 which is the same except for relocation) because, under Alternative 5 (and Alternative 4), more areas of OU4 will be excavated to native soil, requiring no operation and maintenance to maintain protection. In addition, Alternative 5 has the greatest short-term effectiveness because the population that is most at risk will be relocated. Since reduction in toxicity, mobility, and volume is equivalent under all the alternatives, it is apparent that Alternative 5 has the greatest overall effectiveness of any of the alternatives evaluated.

B. *Step two: Compare overall effectiveness to cost to determine whether the remedy is cost-effective*

Once the overall effectiveness of the various remedial alternatives is determined, as EPA has done above in Step 1, overall effectiveness is then compared to cost to ensure that the remedy is cost-effective. A remedy shall be cost-effective if its costs are proportional to its overall effectiveness. *See* 40 CFR § 300.430(f)(1)(ii)(D). In the preamble to the NCP, EPA says this about the use of the term "proportional" in determining cost effectiveness:

> EPA uses the term "proportional" because it intends that in determining whether a remedy is cost-effective, the decision-maker should both compare the cost to effectiveness of each alternative individually and compare the cost and effectiveness of alternatives in relation to one another (*see* 53 Fed. Reg.51427-28). In analyzing an individual alternative, the decision-maker should compare, using best professional judgment, the relative magnitude of cost to effectiveness of that alternative. In comparing alternatives to one another, the decision-maker should examine incremental cost differences in relation to incremental differences in effectiveness. Thus, for example, if the difference in effectiveness is small but the difference in cost is very large, a proportional relationship between the alternatives does not exist. The more expensive remedy may not be cost-effective. EPA does not intend, however, that a strict mathematical proportionality be applied because generally there is no known or given cost-effective alternative to be used as a baseline. EPA believes, however, that it is useful for the decision-maker to analyze among alternatives, looking at incremental differences. EPA believes that using the term "proportional" describes well this type of multidimensional analysis. Using such an analysis should enable the decision-maker to determine whether an alternative represents a reasonable value for the money; more than one alternative may be considered cost-effective.

Table 14 compares the overall effectiveness of each alternative to its cost[7] and to the costs of the other alternatives to see whether the cost of each alternative is proportional to its effectiveness. Based on the analysis summarized in the table, only Alternatives 4 and 5 have been determined to be cost effective.

[7] In the future, if injection of chat and fine tailings is found to be a viable disposal option, the cost of the remedy may change.

20.4 Utilization of Permanent Solutions to the Maximum Extent Practicable

Under the NCP, each remedial action shall utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This requirement shall be fulfilled by selecting the alternative that is protective of human health and the environment, that meets ARARS, and that provides the best balance of trade-offs among alternatives in terms of the five primary balancing criteria. (The balancing criteria are: 1) long term effectiveness; 2) reduction of toxicity mobility and volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost.). The balancing shall emphasize long-term effectiveness and reduction of toxicity, mobility, or volume through treatment. The balancing shall also consider the preference for treatment as a principal element and the bias against off-site land disposal of untreated waste. In making the determination under this paragraph, the modifying criteria of state and tribal acceptance and community acceptance shall also be considered. *See* 40 CFR § 300.430(f)(1)(ii)(E) ("Tribal" acceptance is added to State acceptance per 40 CFR § 300 .515(b)). In this case the Tribe with jurisdiction over part of OU4 is the Quapaw Tribe of Oklahoma.).

None of the remedial alternatives include treatment since the mining waste and mill waste at OU4 is a high volume low-level threat waste and EPA expects to use engineering controls instead of treatment for this type of waste (*see* 40 CFR § 300.430(a)(1)(iii)(B)). Consequently, the second balancing criterion listed in the preceding paragraph is not germane. Moreover, none of the alternatives use off-site land disposal, so that is not a consideration either. In addition, since all of the remedial alternatives (except the clearly unacceptable no action alternative) are protective and all meet ARARs, these provisions are not a factor in the 300.430(f)(1)(ii)(E) analysis either.

In short, as explained in the preceding paragraph, as EPA completes the balancing analysis, the only pertinent criteria are: 1) long term effectiveness; 2) short term effectiveness; 3) implementability; and 4) cost. Also, as we complete our analysis, we can disregard Alternative 1, the no-action alternative, since it does not meet ARARs and is not protective. We can also disregard Alternative 8 since, as explained above in ROD Section 20.3, it is not cost-effective.

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This means that our balancing is limited to Alternatives 4 and 5. Here is how these two alternatives compare under the pertinent criteria listed in the preceding paragraph:

Criterion	Discussed in ROD Section:	Conclusion
Long-term effectiveness	17.3	Alternative 4 and 5 are equivalent
Short-term effectiveness	17.5	Alternative 5 is clearly superior
Implementability	17.6	Alternative 4 is slightly more easy to implement
Cost	17.7, and 20.3	Alternative 5 costs the least and is most cost-effective
Overall		Alternative 5 is best overall

For the reasons described in our above analyses in ROD Sections 20.3 and 20.4 (*see* 40 CFR §§ 300.430(f)(1)(ii)(D) and (E)), of these two alternatives that are protective of human health and the environment and that are ARAR-compliant, the alternative that affords the best combination of attributes is Alternative 5 (Voluntary Relocation, Phased Consolidation, and On-site Disposal), which is also the least expensive of the action alternatives. Moreover, only Alternative 5 includes relocation of the most at-risk population from the area, and relocation is strongly favored in comments EPA received from the affected community (as a matter of policy, EPA places the highest priority on comments received from the community to which the site potentially or actually poses a human health or environmental risk), from the Quapaw Tribe and from the State.

In addition, under EPA's policy, relocation is generally justified to address an immediate risk to human health (where an engineering solution is not readily available). *See Interim Policy on the Use of Permanent Relocations as Part of Superfund Remedial Actions,* OSWER Directive: 9355.0-71P (June 30, 1999). At OU4, the engineering solution (*i.e.,* source removal) will take decades under any of the proposed remedies;

consequently, permanent relocation is warranted. Accordingly, EPA is identifying Alternative 5 (Voluntary Relocation, Phased Maximum Consolidation and On-site Disposal) as the selected remedy in this ROD.

In selecting Alternative 5 as its selected remedy, EPA recognizes the substantial role that States, Indian Tribes, and the community play in the remedial process. When EPA is the lead agency, States and Tribes participate as the support agencies and consult with EPA. In their consultation role, States and Tribes are involved in developing the remedial alternatives for the site and in developing the option that will be put forward as the preferred alternative in the Proposed Plan. The NCP (at 40 CFR § 300.430(f) and at 40 CFR § 300.515(b)) provides for consideration of State and Tribal concerns throughout the remedial process, noting that the EPA shall consider State and Tribal and community comments regarding the lead agency's evaluation of alternatives with respect to the other criteria, and these comments may prompt the EPA to modify aspects of the preferred alternative identified in the Proposed Plan or decide that another alternative provides a more appropriate balance. *See* 40 CFR § 300.430(f)(4)(i). [The NCP, at 40 CFR § 300.515(b) allows Indian Tribes to be treated the same as States in the remedial process if certain conditions are met, thus ensuring the Indian Tribes have the opportunity to review and comment on significant documents such as RI/FSs, and RODs (*see* 55 Fed. Reg. 8730)].

20.5 Preference for Treatment as a Principal Element

The type of mining waste and mill waste that will be addressed at OU4 is a high volume low-level threat waste and EPA expects to use engineering controls instead of treatment for this type of waste under all the alternatives evaluated. *See* 40 CFR § 300.430(a)(1)(iii)(B). Consequently, the statutory preference for treatment would not be met under any of the evaluated alternatives including the selected remedy.

20.6 Five-Year Review Requirements

Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and the NCP at 40 CFR §300.430(f)(5)(iii)(C) provide the statutory and regulatory bases for conducting five-year reviews. Because this remedy will result in hazardous substances remaining on-site in the ground water and in the soils above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will continue to be, protective of human health and the environment.

21.0 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

If a Selected Remedy involves a significant change to a feature of the Preferred Alternative proffered to the public in the Proposed Plan for a Superfund Site, EPA's policy is that the ROD is to indicate the significant changes made, and should provide a rationale for the changes (*e.g.,* new information or arguments provided in public comments). In this case, EPA generally did not change the Preferred Alternative, but only added to it (*i.e.,* EPA added relocation and new timeframes for implementation). In addition, the inclusion of relocation could have been reasonably anticipated based on the extensive discussions of relocation originally presented in the Proposed Plan, in the Remedial Investigation and Feasibility Study Reports (RI/FS), and in the Administrative Record file.

As part of its OU4 Proposed Plan (July 24, 2007), EPA considered relocation as a possible alternative. Alternative 5 was EPA's relocation alternative under the Proposed Plan, and it was rejected because it was not found to be cost-effective. With the passage of WRDA, however, two important aspects of relocation have changed. First, WRDA authorized $30 million for relocation, appropriation of this authorized amount will greatly reduce the number of residents that EPA would have to relocate. Second, under WRDA EPA will not have to apply the Uniform Relocation Act (URA), and this will enable EPA to more efficiently undertake or fund relocation. In addition, comments submitted by the State, the Tribe, and the affected community on EPA's Proposed Plan strongly favored relocation.

As it prepared this ROD, EPA reconsidered relocation in light of the developments described in the preceding paragraph and based on the most recent information available from the LICRA Trust. As explained above in ROD sections 20.3 and 20.4, EPA determined that relocation is cost-effective and provides the best balance of trade offs among the remedial alternatives considered. Accordingly, EPA made Alternative 5 (Voluntary Relocation, Phased Consolidation, and On-site Disposal) its selected remedy.

In the Proposed Plan for OU4, EPA proposed using source materials as fill in subsided areas. The use of placing source material in subsided areas is eliminated from the ROD due to the long-term effectiveness of this technique in the Picher and Commerce area. The Proposed Plan assumed a small percentage of source material would be disposed in subsidence areas, therefore, the change in the overall strategy for the remedy is minimal.

22.0 STATE ROLE

The ODEQ, on behalf of the State of Oklahoma, has reviewed the various alternatives as outlined in the ROD and has indicated its support for the Selected Remedy. The State reviewed and commented on the RI/FS, the BHHRA, the Proposed Plan and the ROD, and has determined that the Selected Remedy is in compliance with ARARs and State environmental laws and regulations.

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PART 3: RESPONSIVENESS SUMMARY

23.0 RESPONSIVENESS SUMMARY

The United States Environmental Protection Agency (EPA) has prepared this Responsiveness Summary for the Tar Creek Superfund Site, and is making it available to the public with the Record of Decision (ROD) of Operable Unit 4 (OU4) of the Tar Creek Superfund Site (the "Site") located in Ottawa County, Oklahoma. This Responsiveness Summary summarizes significant comments, criticisms, and new relevant information submitted during the public comment period (described below) regarding EPA's July 29, 2007, Proposed Plan and the supporting analysis and information for the remediation of OU4.

Pursuant to Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9617, EPA has provided a written notice and brief analysis of the Proposed Plan and made the Proposed Plan available to the public. Also pursuant to Section 117, EPA has provided a reasonable opportunity for submission or written and oral comments and an opportunity for a public meeting near the Site regarding the Proposed Plan and regarding cleanup standards including without limitation remedial action goals and remedial action objectives.

Overview of Public Comment Period

EPA issued its Proposed Plan detailing the preferred recommendations for OU4 for public review and comment on July 29, 2007. EPA published a notice of availability and brief analysis of the proposed plan in a major local newspaper of general circulation Miami News Record on July 28, 2007. This same newspaper announcement told of a public meeting that was held at the Picher-Cardin High School Commons as described below, and announced a 30-day public comment period (July 30, 2007 to date August 30, 2007) on the proposed plan and the supporting analysis and information. Another newspaper announcement was published in the Miami News Record on August 26, 2007, and this announcement extended the public comment period an additional 32 days until October 1, 2007.

Documents containing factual information, data and analysis that may form a basis for the selection of the remedial action for OU4 were made available to the public on July 30, 2007 in three Administrative Record File locations, including the Miami Public Library located in Miami, Oklahoma, near the Site. The EPA conducted a public meeting regarding the proposed plan and regarding supporting analysis and information to receive comments and answer questions on August 28, 2007, at the Picher-Cardin High School Commons located in Picher, Oklahoma. The meeting was in accordance with CERCLA Section 117(a)(2), 42 U.S.C. §9617(a)(2), and 40 C.F.R. §300.430(f)(3). Oral comments were accepted at the public meeting, and a transcript of this meeting is included in the Administrative Record and is available on the internet at: http://www.epa.gov/region6/6sf/pdffiles/transcript_tar_creek_public_meeting_8-28-07.pdf

Administrative Records are maintained at information repositories located at Miami Public Library located in Miami, Oklahoma, EPA-Region 6 Office, and the Oklahoma Department of Environmental Quality.

Miami Public Library
200 North Main St
Miami, OK 74354
918-542-3064

Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73102
405-702-1000

U.S. Environmental Protection Agency - Region 6
1445 Ross Ave
Dallas, TX 75202
214-665-6427 (Please call for an appointment if you desire to review the file)

Highlights of EPA's community outreach efforts are available in Section 23.3.

23.1 Summary and Response to Local Community Concerns[8]

Comment 1: One commenter said "Your plan premise is good, though I don't think it will solve the root of the problem as a whole. Removing chat and chat usage will spread contamination."

In a similar comment, the commenter said that the commenter opposes chat sales on the grounds that use of chat will eventually enter the environment.

Response: The selected remedy for Operable Unit 4, once completed, will effectively remediate over 4,241 acres of source material (see definition in Glossary of Terms in this ROD) to address human health and ecological risk on OU4. Though certain areas containing source material will require institutional controls, the implementation of this action will allow unrestricted land use in most remediated areas. To ensure that chat is used in a manner that is protective of human health and the environment, under the selected remedy, all Site chat that is used, on-site or off-site, must be managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble.[9] This means that we are including both the regulations that apply to transportation construction projects and the preamble guidance that applies to non-transportation, non-residential projects as requirements under the proposed plan as requirements for the use of Site chat. Under the remedy selected in this ROD, only the uses described in the Chat Rule preamble (including EPA's June 2007 fact sheet; EPA530-F-07-016B) and the transportation construction project uses described in 40 CFR Part 278 will be allowed for Site chat. As explained in the preamble to the Chat Rule, these uses will be protective. Chat that is not sold, for example a chat base that remains after most of a chat pile is sold, will be disposed on-site in repositories. On-site repositories will be constructed to accept Site source materials for final disposal. The repositories will cover an estimated 28 acres and will be capable of receiving an estimated 1,000,000 yd^3 of source materials, affected soils, and other Site-related materials such as wood, concrete, and miscellaneous debris. The liners for on-site repositories that are not built in areas of contamination shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-11-2(b) unless an alternative is approved by EPA consistent with OAC 252:515-11-2(c). The cover shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-19-53(a) or an equivalent alternative as determined by EPA consistent with OAC 252:515-19-53(c). The requirements of OAC 252:515-19-53(a) include a barrier layer that is at least 24 inches of earthen material. The requirements also include the installation of an erosion layer above the barrier layer. The erosion layer is to be at least one foot of soil capable of sustaining plant growth, comply with the Oklahoma Solid Waste Management Act Title 252 OAC, Chapter 515 for construction of a non-hazardous industrial waste landfill or the equivalent as determined by EPA. As explained in ROD Section 19.2 (Description of the Selected Remedy), some chat may also be injected into underground mines which should virtually eliminate the chance of human exposure. In these ways we will ensure that chat that is removed will not spread contamination.

Comment 2: The mines that feed into Tar Creek are not examined in your plan. Unless you start with the mines that feed Tar Creek, while simultaneously cleaning the chat and treating neighboring areas, you won't solve the problem.

Response: OU4 generally is not intended to address mine water or the surface water and sediment in Tar Creek. However, the excavation of in-stream source material and the erosion control measures that will be taken under OU4 to address near-stream source material should eliminate principal sources of surface water and sediment contamination in Tar Creek and other Site streams.

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[8] EPA received a letter dated February 13, 2008, from the Quapaw Tribe of Oklahoma. Their concerns are addressed in this ROD.

[9] The Chat Rule can be found at 72 Fed. Reg. 39235 (July 18, 2007). It can also be found at http://www.epa.gov/epaoswer/other/mining/chat/.

Comment 3: One commenter said that EPA should consider use of encapsulation technology provided by the Environmental Toxins Solution, Inc. Company to contain site contaminants. Another commenter said that EPA should consider use of Laura's Mix, a new innovative solidification technology for remediation at Tar Creek OU 4.

Response: EPA is always interested in learning more about innovative technologies that offer permanent and cost effective solutions for contaminants at any Superfund site. Over the years, EPA has met with multiple vendors and heard and learned more about various proposals and technologies that were proposed to EPA as solutions for source material at the Site. Unfortunately, a number of the proposals that were presented did not have documentation to support the claimed findings. Nonetheless, under the ROD, in addition to the transportation uses of chat that are described, Site chat may also be used in cement and concrete non-residential construction projects as described in the preamble to the Chat Rule, and in applications that encapsulate the chat as a material for manufacturing a safe product or as part of an industrial process (*e.g.,* glass, glass recycling) where all waste byproducts are properly disposed, as described in the June 2007 fact sheet. Non-transportation cement or concrete project material in question must, on a case-by-case basis, pass one of the two evaluation methods described in the Chat Rule preamble guidance. The two evaluation methods concern testing the material using the Synthetic Precipitation Leaching Procedure, or having a State environmental agency or EPA conduct a site specific risk assessment with a public comment period (*see* ROD Section 19.2.2 (Environmentally Acceptable Chat Use); *and see* the preamble to the Chat Rule for more information). In short, chat uses that meet these various criteria may be used to contain contaminants. If the technologies that the commenters describe meet these criteria, they may also be used.

Comment 4: Your statement says, "clean up Tar Creek and protect the people…" The greatest "protection" you can provide the current residents of this community is the opportunity to relocate through the Federal Buyout already in progress here.

Response: The voluntary buyout being implemented by the Lead Impacted Communities Relocation Assistance Trust (LICRAT) is part of the State of Oklahoma's voluntary buyout. After receiving many comments like this from the affected community, from the Quapaw Tribe of Oklahoma (the "Tribe") and from the Oklahoma Department of Environmental Quality (ODEQ), and after the passage of WRDA 2007, EPA reevaluated relocation. As a result, the selected remedy for OU4 was modified to include relocation. Thus, any remaining properties in the target area—generally Picher, Cardin and Hockerville, not addressed under the State buyout program will be addressed under EPA's selected remedy. The relocation will follow the procedures and priorities established by LICRAT. It will also be administered by the LICRAT.

Comment 5 and Response: Junior and high school students, including the students of Miami High School, submitted the comments in the following enumerated paragraphs. EPA's responses follow each comment:

1) Some students voiced opposition to chat sales;

Regarding the safety of chat sales, please see EPA's response to Comment 1 above in this section of the ROD (Section 23.1(Summary and Response to Local Community Concerns)).

2) Some students were concerned about what is being planned for abandoned mine shafts;

EPA does not address abandoned mine shaft safety hazards other than those associated with contamination. EPA has entered into a memorandum of understanding with several other Federal agencies, including some that have the authority and resources to address open mine portals. EPA transmits information that it has regarding physical safety hazards associated with mine portals to these other Federal agencies. These agencies include: the U.S. Army Corps of Engineers and the Department of the Interior.

3) Some students said they were concerned that the project would take too long;

EPA has structured the remediation of OU4 so that the most pressing environmental and human health hazards are addressed fairly quickly. In particular, once the remedial action begins, remaining target residents in Picher, Cardin, and Hokcerville should be relocated within three years. Simultaneously, Phase 1 activities, which are intended to address pressing problems, such as in-stream source material and fine tailings deposits, will also take place in the near term. (For more about Phase 1, please see ROD Section 19.2.4 (Phase 1 Elements).) With residents out of the higher risk areas, it is reasonable to allow the chat, a valuable commodity, to be sold at the pace that the market can handle.

4) Some students had questions as to whether there will be funding available to complete the project;

As part of its Enforcement First policy, EPA intends to seek funding from potentially responsible parties (PRPs) who may be liable for EPA's costs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also called Superfund. Costs that the PRPs do not cover must come from EPA appropriations. When EPA pays for the cost of remediation at a Superfund site in Oklahoma, the State provides 10% of the funds.

5) Some students suggested that the mine drainage should be stopped from impacting water quality;

OU4 generally is not intended to address surface water. However, the excavation of in-stream source material and the erosion control measures that will be taken to address near-stream source material should eliminate principal sources of surface water and sediment contamination in Tar Creek and other Site streams. Mine drainage is not part of OU4.

6) One student suggested that the project should be stopped after the buyout of residents is complete.

While relocation of nearby residents will help eliminate the human exposure to source materials, it will not eliminate the human health risk. In addition, the source material poses a risk to Site biota that must be addressed.

Comment 6: The Seneca-Cayuga Tribe of Oklahoma requests that the EPA utilize a native seed mixture to apply to all remediated soils as ground cover, instead of a general vegetative cover as suggested.

Response: EPA will work with all the area Tribes and the Oklahoma Department of Environmental Quality (ODEQ) during the remedial design phase to develop revegetation plans. Native grasses will be considered as part of the design. As reflected in the ROD, the soils will be rebuilt naturally to sustain vegetation using standard land preparation practices such as ripping, contouring, adding amendments, disking, fertilizing, planting and seeding. Excavated areas will not be backfilled with a soil cover. Where a cover is used to cap source material, it will meet the substantive requirements of the ODEQ regulations at OAC 252:515-19-53(a) or an equivalent alternative as determined by EPA consistent with OAC 252:515-19-53(c). The requirements of OAC 252:515-19-53(a) include a barrier layer that is at least 24 inches of earthen material.

Comment 7: Don't spend any more money on the remedy or remove chat until all residents are gone.

Response: As part of Phase I of EPA's remedy for OU4, EPA will provide funds to LICRAT, through ODEQ, to relocate any remaining residents and businesses not addressed under the State buyout program. Concurrently, EPA will excavate chat and chat bases in remote areas (*i.e.,* distal areas that are not near populated areas) down to native soil. Excavated chat will be transported to an on-site processor and released to that processor, or it will be disposed in on-site repositories. These activities will contribute to the protection of human health and the environment and will produce land that can be used without restriction.

Comment 8: One commenter pointed out that the EPA issued a new rule on chat that was released June 6, 2007. The commenter went on to say that, in the commenter's view, moving the chat from the Tar Creek area is in violation of the EPA rules. The commenter also said that anybody involved in the moving the chat should be considered generators and help pay for the removal of the hazardous waste. Another

commenter asked "How does the proposed plan address environmental liability for chat haulers who take chat beyond the boundaries of the site."

Response: Removing or hauling chat from the Site for off-site use is not a violation of the Chat Rule, and it is consistent with the ROD. Moreover, a person who removed chat from the Site and who subsequently used the chat properly as described in the ROD and the Chat Rule would not be liable (as a generator or otherwise) under CERCLA because, if properly used, the chat would not have been released to the environment.

To ensure that Site chat sales continue and that chat is used in a fashion that is protective of human health and the environment, all Site chat will be managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble. This means that we are including both the regulations that apply to transportation construction projects and the preamble guidance that applies to non-transportation, non-residential projects as requirements under the selected remedy. In addition, only the uses described in the preamble (including EPA's June 2007 fact sheet; EPA530-F-07-016B) and the transportation construction project uses described in 40 CFR Part 278 will be allowed for Site chat, as described in the ROD.

In addition, the ROD makes it clear that chat that is taken off-site, must be sent only to a facility that is acceptable under the Off-site Rule (40 CFR §300.440). EPA is the agency that determines whether a facility is acceptable for the receipt of CERCLA waste from a Superfund Site. Therefore, EPA will make acceptability determinations regarding facilities that receive chat from the Site.

EPA is selecting the Chat sales program as outlined as part of the remedy for the Tar Creek Superfund Site. Because chat sales are part of the remedy, EPA will facilitate activities to support chat sales that will include the following:

a) The EPA will work with the DOI to facilitate sales of Indian-owned chat.
b) EPA will present a workshop to assist chat/land owners and sellers with chat sales.
c) EPA will provide sample chat sale agreements and site operating plans to chat/land owners and chat processors.
d) EPA will answer questions about the Chat Rule.
e) EPA will provide technical review to any requests for chat use other than chat mixed in asphalt for federal transportation projects.
f) EPA will conduct a risk assessment on chat materials that exceed the SPLP and proposed for use in concrete as specified in the Chat Rule to support the ultimate sale of the chat.
g) EPA will coordinate with DOJ regarding liability protection for chat/land owners.

Please see ROD Section 19.2.2 (Chat Sales and Environmentally Acceptable Chat Use) for more information.

Comment 9: I do not understand why nearly 8 hours before the meeting it was announced to and by the media that a thirty (30) day extension was made by EPA Region 6 for the OU4 official public comment period. What impact will the extension have on EPA plans for OU4.

Response: No. In accordance with and as part of its public participation responsibilities under CERCLA, a 30 day comment period is provided to allow the public to review and provide comments on EPA's Proposed Plan and the supporting documents contained in the Administrative Record File. If a request for an extension is received prior to the conclusion of the comment period, EPA may provide an additional 30 days to receive any additional comments. The comment period was scheduled to conclude August 30, 2007. A request was received, and EPA informed the public at the public meeting held on August 28, 2007 that the comment period would be extended until October 1, 2007. A notice of the extension was also published in the local newspaper on August 30, 2007. Public comments are one of 9 criteria that assist EPA in its selection of the remedy for a Superfund site or for an operable unit of a Superfund site.

Comment 10: Under the proposed plan (4), flotation ponds and fine source material will be capped and vegetated. Our concern is where these repositories will be fenced and posted, or otherwise made obvious to the public that these areas are off limits.

Response: As explained in ROD Section 19.2.6 (Other Planned Actions Common to Both Phases), to help eliminate the possibility of potential exposure to Site source materials, community education and awareness activities will be conducted throughout the duration of the remedial actions. These activities will include, but not be limited to, the following:

- Outdoor billboards located near chat piles that have been used in the past for recreation, warning of the dangers associated with playing on chat piles.
- Biannual notices in utility bills warning of the dangers of chat use in residential areas, and warning people to stay off of chat piles.
- In-school programs to warn children to stay off of chat piles.
- Outreach to community churches, and social groups.

In addition, the selected remedy requires Institutional Control (ICs) to aid in the management of the wastes left on-site and to ensure that only appropriate reuse options are implemented. ICs that will be used include deed notices placed on land parcels that are contained in the Site. ICs would notify current and potential future deed holders of the presence of wastes left on-site. The deed notices would identify the reason for the notice, the affected property, the remedy, engineering controls, and land and ground water use restrictions. ICs will also create an easement granted to ODEQ for continued remedial response. The deed notices would be filed by the ODEQ should the property owner decline. If DOI is the trustee for the property where wastes are covered and left in place, then IC's will be developed in coordination with DOI. No fencing or posting is contemplated under the remedy.

Comment 11: Under the Operation and Maintenance stage, will the repositories be mowed periodically in order to reduce the growth of woody plants with roots that could compromise the sodded liners and thereby become an attractive nuisance for wildlife?

Response: Generally EPA's repositories in like circumstances are mowed to prevent the type of root intrusion that the commenter describes, but this will be decided in Remedial Design. Selection of the repository location will consider proximity to existing source material locations, thickness of underlying soil deposits, soil type, depth to ground water, and presence or proximity of floodplains or other surface water features. Components of the on-site repository and the criteria for maintaining the repository will be developed during the Remedial Design.

Comment 12: How can you insure that deep tilling of soils contaminated with smelter waste and transition zone soils will not become an attractive nuisance to wildlife?

Response: The soil remediation goals established for OU4, will address ecological risks at the site. Soils contaminated above the remediation goals will be excavated and removed. Deep tilling is expected to further reduce the chemical concentrations in the soil. Deep tilling of soils, particularly compacted soils that may underlie source material removal areas, will increase infiltration and prevent runoff, and the aeration that occurs will be beneficial to vegetation establishment. This method is expected to meet the Remedial Action Objectives and remediation goals for soil; therefore, institutional controls and long-term operation and maintenance are not expected.

Comment 13: EPA ignored information about subsidence risk (USACE "Picher Mining Field Northeast Oklahoma Subsidence Risk Evaluation") in developing the Preferred Alternative for OU4.

Response: The referenced USACE study is part of the Administrative Record for the ROD. The study was carefully reviewed by EPA as it developed the selected remedy to ensure that subsidence would not interfere with our selected remedy. Generally speaking, however, subsidence considerations will play more of a role during Remedial Design (RD). For example, when EPA is deciding where to place repositories as part of RD, subsidence risks will be a factor. EPA and other Federal agencies involved at

the Site work together within their respective authorities, and share information. In fact, a Memorandum of Understanding (MOU) was signed in May 2003 between the EPA, the Department of Interior, and the U.S. Army Corps of Engineers. The purpose of this Memorandum is to facilitate a coordinated response to environmental contamination, physical safety concerns (open mine shafts, subsidence, and flooding), and poor economic conditions at the Tar Creek area. To deal with the overlapping authorities and jurisdictions that exist, the MOU helps coordinate efforts and promotes the exchange and sharing of information among these agencies. Other participants in this effort include the U.S. Fish & Wildlife Service, the U.S. Geologic Survey, the U.S. Bureau of Indian Affairs, and the Tribes.

Comment 14: EPA should reconsider it plans for OU 4. With the people removed, the entire project can be reevaluated. We would suggest that the list of priorities should start with public safety and health, and subsequent buyout, should be refocused to limit environmental damage to the watershed. In this setting, there would be no pressure to push chat sales past economic realities, and the process of chat removal and the permanent storage of fines can be explored at a safe, rational and commercially viable pace.

Response: EPA reexamined the preferred alternative based on public comments and the provisions provided by WRDA for voluntary relocation. The preferred alternative was modified to include voluntary relocation and an extended timeframe for chat sales to continue an additional 10 years, for a total of 30 years. With these and other modifications to the plan, the concerns identified above will be addressed.

Comment 15: EPA's proposed plan does not have state support, and will not have state support until it includes a residential buyout.

Response: Based on State, Tribal and community concerns with the Preferred Alternative and in view of the passage of WRDA which allows EPA to undertake relocation without applying the Uniform Relocation Act (URA), EPA has incorporated voluntary relocation as part of the remedy and the State of Oklahoma, acting through the Oklahoma Department of Environmental Quality (ODEQ), now concurs with the selected remedy.

Comment 16: Exempt chat that falls under a 400 parts per million lead standard from requirements described in the proposed plan.

Response: In deciding what uses of Site chat would be acceptable (*see* ROD Section 19.2.2 (Environmentally Acceptable Uses of Chat)), EPA looked to uses identified in the Chat Rule and its preamble because those uses were found to be safe, based on the extensive scientific study that is documented in the preamble to the Proposed Chat Rule (71 Fed. Reg. 16729 (April 4, 2006)) and in the preamble to the Final Chat Rule (72 Fed. Reg. 16729 (April 4, 2007). While chat that contains lead at concentrations of less than 400 parts per million does not exceed EPA's remediation goals for the Site, that does not mean that use of such chat is risk free. Lead is a dangerous hazardous substance, and exposure to lead should be avoided. *See* "Preventing Lead Poisoning in Young Children, A Statement by the Centers for Disease Control" (October, 1991). Under the selected remedy, only those uses of Site chat identified in the ROD are allowed because those are the uses that EPA has determined to be safe.

Comment 17: Would buyers of chat be required to sign a waiver releasing seller from liability?

Response: No waiver will be required. However, the record keeping requirements found in the Chat Rule will apply (see ROD Section 19.2.2 (Environmentally Acceptable Uses of Chat)) . The Chat Rule can be found in the July 18, 2007, edition of the Federal Register at pages 39331 to 39353 or at this website:

http://www.epa.gov/fedrgstr/EPA-WASTE/2007/July/Day-18/f13544.htm

EPA plans to conduct multiple workshops, and provide fact sheets to explain the ROD requirements for the use of Site chat.

Comment 18: What alternative water supply will be provided for contaminated rural residential wells? With the buy out taking place, it has been stated, that once it (buy out) is complete, all public services (electric, water, etc.) will be shut off to the Tar Creek Area.

Response: Under the ROD, an alternative water supply will be provided to OU4 residences using private wells for drinking water where drawn well water concentrations exceed the National Primary Drinking Water Standard of 0.015 milligrams per liter (mg/L) for lead. Two private wells were identified as exceeding the standard. Due to the uncertainty as to what sort of water supply systems will remain after relocation of target residents is complete, the method for supplying the water will be determined during the Remedial Design stage of the remedy. If, as part of the remedial action, eligible households are connected to existing municipal or rural water supplies, the owner/residents of these households would be responsible for payment of continued water service and for household water system repairs. That is, the remedial action will provide the connection to the alternative water supply to eligible households, but it will not pay for water service or for household plumbing repairs or for system repairs.

Comment 19: What good will it do to remediate yards after the relocation program is complete? There will still be source materials and contamination in the area, so any yards left to remediate will eventually become contaminated again.

Response: Residents in rural areas that elect not to participate in the State of Oklahoma's relocation program, whose residential yards are found to have concentrations of soil lead that exceed 500 ppm will be remediated by EPA. As described in the ROD, EPA intends to address the source materials (*i.e.,* the chat, the fine tailings, and the smelter waste). Once the source material is removed, areas that were once uninhabitable will provide a healthier environment and the productive use of land. EPA is unaware of any sources, other than anthropogenic activities (*e.g.,*use of chat as fill in a previously uncontaminated area, installation of a chat driveway in an uncontaminated area), that would recontaminate a remediated residential yard. Present day air deposition of lead-contaminated dust, for example, has been monitored and found to be insignificant.

Comment 20: The Wyandotte Nation supports the use of institutional controls and operation and maintenance activities, however, as needed is not an acceptable time frame. How often and for how many years to come will these institutional controls take place, and who will oversee them?

Response: Though the types of institutional controls that are needed at this site are identified in the OU4 ROD, establishing these controls in an effective manner will require the collective efforts and feedback of our Federal, State, Tribal and local county representatives. The specifics involving duration and the parties that will be responsible for monitoring these controls will be better determined during the Remedial Design. EPA intends to work with its counterparts to ensure the items that have been identified in the comment are fully addressed. The five-year review process will also evaluate the effectiveness of institutional controls.

Comment 21: What about the ground water contamination that will still exist?

Response: Studies to date at the Site have not found any significant contamination of the Roubidoux Aquifer, the principal drinking water aquifer in the area. The mines were excavated in the shallower Boone Aquifer. The Boone is contaminated with metals at concentration levels that exceed MCLs; accordingly, it is not fit to drink. As part of the selected remedy, EPA will provide alternative drinking water supplies to residents using wells that draw from the Boone or other contaminated ground water as provided in the OU4 ROD. In an EPA action that is separate from the OU4 response action, EPA is conducting a hydrogeologic study of the ground water. Next steps will be determined once this study is complete. EPA estimates that the study will be completed in 3 years.

23.2 Summary and Response to Specific Legal and Technical Questions

Comment 1: The Tribe suggests that the EPA should be consistent at the Tar Creek site with the Cherokee County, KS site on their clean up levels for lead (use 400 mg/kg, as opposed to 500 mg/kg). The sites are contiguous and cleanup should have the same remediation goals.

Response: In developing its remediation goals for OU4, EPA Region 6 considered the Ecological Remediation Goals developed for Cherokee County, Kansas by Region 7. The Region 7 analysis recommended a range of values for lead in soil that would be protective for exposed terrestrial wildlife. The Region 7 recommended soil remediation goals for lead ranged between 377 and 1,175 milligrams per kilogram (mg/kg). EPA Region 7 used these remediation goal ranges when it selected the remediation goals for the Cherokee County, Kansas, Site in the Amended Record of Decision dated September 29, 2006. Based on the similarity of the ecologies in the two areas (Region 7 Draft Ecological Preliminary Remediation Goals, Cherokee county Superfund Site (July 14, 2006) Memorandum from Jon Rauscher, May 24, 2007), it is appropriate to use the same ranges for OU4 remediation goals. The remediation goal for lead at Tar Creek is 500 mg/kg because that is within the range recommended in the Region 7 report, and because EPA Region 6's Baseline Human Health Risk Assessment for Operable Unit 2 (Residential Areas), based on the Integrated Exposure Uptake Biokinetic Model (IEUBK), found that 500 mg/kg was protective of human health. In short, based on the Region 7 report, 500 mg/kg is protective of the environment and based on the Region 6 study, it is also protective of human health.

Comment 2: The Tribe would request the preferred alternative adapt the portion of Alternative 8 that addresses completely removing in/near stream waste and integrating it into existing upland chat deposits as an early response. The Tribe feels the complete removal of the in/near stream chat is more beneficial overall, and in the future, for the recovery of our injured natural resources.

Response: The selected remedy addresses all near-stream source materials and in-stream source materials; although, there are different timeframes for the completion of the remedial actions associated with each. Early Phase 1 actions will be implemented for in-stream source materials. As an interim measure, sheet piling, berms, constructed wetlands, or other engineering controls will be installed to control near-stream source materials in order to help prevent contamination from migrating to surface water. Final disposition of the near stream source materials will be addressed under Phase 2 actions that are consistent with ongoing chat processing at these locations.

Comment 3: The Tribe requests a monitoring plan be developed and implemented for all on-site repositories or chat injection sites to insure that surface and ground water contamination is not continuing.

Response: EPA agrees. Though EPA will not commence full-scale injection until the hydrogeologic study is complete, a monitoring plan will be included for any injection and a monitoring plan will be included in the Operations and Maintenance Plan for the repositories.

Comment 4: The proposed plan (4) relies on commercial means as the primary removal mechanism for the chat piles. How can you guarantee that chat used in asphalt and as a road base will not be used in residential areas? Will the EPA regulate chat sales, hauling, and use in the same manner as the Department of the Interior (DOI)? Further, how will the repair of roads that are chat based and covered with chat/asphalt mix be managed in order to protect human health and the environment? Of special interest is whether or not asphalt (chipped crumbled) during reconstruction will be made available to the public for private use or will it be totally recycled into new road covering? How will road base be contained during reconstruction in order to protect human health and the environment?

Response: Chat, which makes excellent gravel, is one of those materials. In order to avoid releases of untreated chat into the environment, EPA will ensure, as part of its responsibilities under the Off-site Rule, that facilities (*e.g.,* asphalt mixing plants, glass factories) where chat is taken are determined to be

acceptable under the Off-site Rule, 40 CFR § 300.440. Moreover, as explained in ROD Section 19.2.2 (Chat Sales and Environmentally Acceptable Chat Use), only certain uses of Site chat will be allowed. To help ensure that only these uses take place, EPA's ROD requires that acquirers of chat complete the paperwork requirements of the Chat Rule for all Site chat use, and that copies of the required submissions be sent to EPA's Remedial Project Manager (RPM) for OU4. EPA will conduct on-site seminars to explain these requirements. As with any hazardous substance, if it is released to the environment, the responsible parties may face CERCLA liability, and the risk of such liability should help ensure responsible behavior.

Comment 5: Selling chat will serve only to spread contamination and is neither economically feasible, nor can this portion of the remedy be completed in 20 years.

Response: Please see EPA's response to the first comment in Section 23.1 (Summary and Response to Local Community Concerns).

Comment 6 (a): The Department of the Interior (DOI) remains concerned that issues such as the exercise of EPA's CERCLA authority to explicitly authorize chat sales as a fundamental component of the final remedy has yet to be addressed by the Proposed Plan.

Comment 6(b): Chat sales are appreciated along with the anticipated potential removal of as much as 95% of contaminants from the site, as incorporated into discussion of the remedy. The plan does not however specify which agency will provide legal oversight over the chat sales, and the Plan could be interpreted to only encourage chat sales, rather than explicitly authorize them as a CERCLA remedy.

Response: Chat sales are part of the CERCLA remedy. See ROD Section 19.2.2 (Chat Sales and Environmentally Acceptable Chat Use). As part of the selected remedy for Tar Creek Superfund Site Operable Unit 4 (OU4), EPA will facilitate activities to support chat sales that will include the following:

a) EPA will work with the DOI to facilitate sales of Indian-owned chat.
b) EPA will present a workshop to assist chat/land owners and sellers with chat sales.
c) EPA will provide sample chat sale agreements and site operating plans to chat/land owners and chat processors.
d) EPA will answer questions about the Chat Rule.
e) EPA will provide technical review to any requests for chat use other than chat mixed in asphalt for federal transportation projects.
f) EPA will conduct a risk assessment on chat materials that exceed the SPLP and proposed for use in concrete as specified in the Chat Rule to support the ultimate sale of the chat.
g) EPA will coordinate with DOJ regarding liability protection for chat/land owners.

In addition, EPA has expanded the provisions of the Chat Rule to cover all Site chat use. See ROD Section 19.2.2 (Environmentally Acceptable Chat Use). By expanding the provisions of the Chat Rule to cover the use of Site chat, EPA is helping to ensure that chat is used in an environmentally acceptable manner. Finally, EPA itself will make sure that all off-site facilities receiving Site chat are acceptable within the meaning of the Off-site Rule, 40 CFR § 300.440.

Comment 7: The Proposed Plan discusses the total present value of the life of any alternative to be chosen as the final remedy which, as we have provided previous documentation to you, for exceeds DOI budgeting as a part of our trust responsibility for these chat sales.

Response: Under the NCP, cost can only be considered in selecting a remedy from among protective alternatives. The remedy selection process requires that alternatives must be demonstrated to be protective and ARAR-compliant (or justify a waiver) in order to be eligible for consideration in the balancing process by which the remedy is selected. This sequence of steps ensures that the selected remedy will be protective of human health and the environment. Cost is a relevant factor for consideration as part of the selection of the remedy from among protective, ARAR-compliant alternatives. As explained in ROD Section 20.3 (Cost Effectiveness), the selected remedy is cost effective. It is also the least expensive of the protective remedies, measuring present value.

Comment 8: It is recommended the following language be substituted for the Paragraph beginning at the bottom of Page 1: The EPA agrees with the local community, the State, the Tribe, and the DOI that such sales should continue as an authorized and integral part of any proposed remedy (except the no further action alternative). To ensure that chat is used in an environmentally acceptable fashion, the EPA proposes to require that all Site chat that is sold and used must be managed according to the criteria provided in the Chat Rule, 40 C.F.R. Part 278 and the preamble thereto. The EPA further agrees with the aforementioned interested parties that in order to achieve the maximum environmental benefit from chat sales, the EPA proposes to authorize and oversee all chat sales at OU4 as a CERCLA remedy, and require and ensure that all such sales comply with all applicable environmental requirements (including , but not limited to, the Chat Rule). The EPA proposes to work with the State of Oklahoma, the Quapaw Tribe, and the Department of the Interior to identify and incorporate in the Final Plan any applicable environmental standards that should apply to all chat sales at OU4. Further, the EPA proposes to coordinate with its governmental partners such tasks as necessary to encourage and enable the adoption of the Chat Sale Pilot Project into the remedy for the site.

Response: The concepts discussed in the Proposed Plan paragraph that you have referenced are generally incorporated into ROD Section 19.2.2 (Environmentally Acceptable Chat Use). The ROD does expand the provisions of the Chat Rule to cover the use of Site chat. *See id.* Provisions regarding coordination with the U.S. Department of the Interior, the commenter, are incorporated into the following parts of the ROD: 16.2.6 (Institutional Controls); Section 19.2.2 (Environmentally Acceptable Uses of Chat); 19.2.6 (Other Planned Actions Common to Both Phases); and 19.4.1 (Available Uses of Land). EPA's intention to encourage Best Management Practices is also discussed at ROD Section 19.2.2 (Environmentally Acceptable Uses of Chat).

Comment 9: The map and discussion of "distal areas" is unclear and should be clarified.

Response: The distal areas are remote areas with generally sparse source chat deposits located away from the central mining areas that have the largest chat piles. Clearing the distal areas of chat as part of Phase 1 of the selected remedy is intended to rapidly establish a significant reduction in the footprint of source materials on the Site in order to leave less land with future use restrictions and long-term operation and maintenance requirements. The figures (*i.e.,* illustrations) included in the ROD represent the areas defined as distal areas. The distal areas were established based upon local watersheds. The intention is that, by removing source material in each of those watersheds, there should be a commensurate improvement in water quality. As part of a more detailed analysis for the Feasibility Study and to develop refined cost estimates, the distal areas (and the source materials present) were divided into a Northeast, Southeast, and the Elm Creek Distal Zones. The map that depicts distal areas in the Proposed Plan was somewhat modified in the OU4 ROD, as was the discussion of the distal areas.

Comment 10: The plan does not specify which agency will be certifying Off-Site Rule compliance. The Department of Interior continues to maintain that the EPA is the appropriate agency for such compliance certification.

Response: The ROD makes it clear that chat that is taken off-site, must be sent only to a facility that is acceptable under the Off-site Rule (40 CFR §300.440). EPA is the agency that determines whether a facility is acceptable for the receipt of CERCLA waste from a Superfund Site. Therefore, EPA will make acceptability determinations regarding facilities that receive chat from the Site.

Comment 11: In all the Alternatives, the proposed time frames for chat sales are too compressed and appear to be internally contradictory.

Response: As reflected in the Record of Decision for OU4, the timeframe for chat sales has been modified. Since residents facing the greatest risk of exposure will now be relocated, the EPA has extended the timeframe for chat sales an additional 10 years, from 20 years, to 30 years. Additional information on this modification is in ROD Section 4.0 (Description of the Selected Remedy).

Comment 12: It is unclear from the Plan what process will be utilized to determine chat pile commercial viability.

Response: As part of future five-year reviews, EPA will evaluate the progress of chat sales. Chat piles and bases remaining after 10 years will be evaluated for commercial viability. This determination will be made using input from the chat/land owners, appropriate Tribal representatives, and the commercial operators. *See* ROD Section 19.2.2 (Environmentally Acceptable Chat Use).

Comment 13: On page 4 of the draft Plan, the proposed Notice provides for the EPA to have determined that a particular chat pile poses "a significant risk to public health and safety." However, Page 11 of the Plan it states that "exposure through the ambient air inhalation route of intake poses no health risk." It is unclear how the EPA could make a determination that a pile poses "a significant risk to public health and safety" in light of the statement on Page 11.

Response: On page 11 in the same paragraph where it states that risk through the inhalation route presents a minimal risk, it also says that the primary human exposure at OU4 occurs through incidental ingestion associated with normal hand to mouth contact after contact with source materials. Surface layers of piles that are left undisturbed become crusted and hinder dust from being emitted through the air. However, when a chat pile is disturbed by people walking or playing on the pile surface, the contaminants become available through the dermal, inhalation and ingestion routes of intake. The risk assessment evaluated the risk from exposure to contaminants in the piles by adolescents or young children who play on these piles. Such activities by young children or adolescents presented a significant risk through the incidental ingestion route of intake that could not be ignored. The EPA has documented recreational activities on chat piles undertaken by adolescents and young children in photographs and digital recordings that are part of the OU4 Administrative Record.

Comment 14: Air Monitoring: If exposure through the ambient air inhalation route of intake poses no health risk, it is unclear why and whether air monitoring of chat sales and removal operations is necessary. If air monitoring is not necessary, it is unclear whether the listed expenditures for environmental monitoring (which is presumed to be based upon the St. Joe pilot Project Model) are necessary.

Response: Air monitoring is a Best Management Practice (BMP) component of the remedy that will be performed as needed, as determined by EPA, during chat processing. The intent is to confirm air quality and the effectiveness of the dust mitigation measures. BMPs are broadly defined by EPA under Section 304 of the Clean Water Act (including its implementing regulations at 40 CFR § 122.44(k)) as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of water of the U.S. BMPs include treatment requirements, operating procedures, and practices to control industrial site runoff, spillage or leaks, or drainage from raw material storage piles, erosion controls, dust suppression methods, or air monitoring.

Comment 15: The plan does not specify which agency will be enforcing the State of Oklahoma's ARARs, and which agency will be spending or receiving $12,500,000 for Off-Site Rule Acceptability Determinations.

Response: The combined efforts of EPA, ODEQ, and the Oklahoma Water Resources Board will be used to ensure that certain components of the remedy comply with the identified Federal and State ARARs, listed in Table 13 of the ROD. With respect to the Off-site Rule Acceptability Determinations, please see the response to Comment 10 above in this section.

Comment 16: It is unclear what the Quapaw Tribe and the Oklahoma Department of Environmental Quality will be tasked to perform in exchange for their respective receipt of over $1,000,000.

Response: The cost estimate is for Management Assistance for the Quapaw Tribe and the Oklahoma Department of Environmental Quality to compliment EPA’s effort in overseeing the remedy for 25 years.

Comment 17: How does EPA feel that deep tilling will solve the problem of contamination levels in soils? It is our concern that deep tilling will only cover up the contamination for a period of time, but, eventually, the contamination will work its way to the top, and we will be subject to the age old contamination problem.

Response: Deep tilling is prescribed in all action alternatives to address transistion zone soils, smelter-affected soils, and soils underlying source materials once the source materials have been excavated and removed. Deep tilling of soils following source material excavation is expected to meet the Remedial Action Objectives (RAOs) and remediation goals for soil and has proven effective in reducing Chemical of Concern (COC) concentrations below risk-based levels in some chat bases with minimal contamination and in transition-zone soils at other Tri-State Mining Sites. In addition, deep tilling of soils, particularly compacted soils that may underlie source material removal areas, is an effective method of increasing infiltration and preventing runoff, in addition it improves aeration which is beneficial to vegetation establishment.

Comment 18: High concentrations of lead are addressed under the preferred remedy identified in this "Proposed Plan; however, the concentrations of lead are not so high as to be several orders of magnitude above levels that allow for unrestricted use and unlimited exposure. Therefore, the lead is not considered to be a principal threat under the NCP consequently, there is no expectation under the NCP that the lead be treated. This comment is very conflicting and makes no sense. If you don't have to address the lead under the NCP, why are you addressing it?

Response: The operative word in the cited Proposed Plan passage is “treated.” Since the lead is not a principal threat waste, there is no expectation that it be treated. Although lead at this Site is not considered a principal threat waste under National Contingency Plan (NCP), high concentrations of lead found in OU4 are a threat to Human Health and the Environment. The EPA conducted a Baseline Human Health Risk Assessment and an Ecological Risk Assessment for the same ecological zone. Based on these studies, it was determined that there is sufficient risk to human health and to the environment from releases of lead, cadmium, and zinc that the selected remedy is necessary to protect public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

Comment 19: It would make sense for the clean up levels at Tar Creek to be consistent with the clean up levels at Cherokee County, Kansas of Clean up level of 400 mg/kg.

Response: See response to Comment 1 in this section.

Comment 20: How can you attain zero discharge in cadmium, lead and zinc from source materials to surface waters?

Response: The EPA defines zero discharge as discharge concentration levels that would be consistent with the concentration levels that would be expected from soil that has background concentrations of these chemicals. The primary goal is to eliminate discharge of these metals by preventing direct runoff and seepage from the source materials into surface water bodies found within the site. This may mean physically moving the material away from the surface water body or deploying other engineering controls (*e.g.,* sheet pilings, berms and constructed wetlands) to prevent the discharge from reaching the surface water body.

Comment 21: What alternative water sources? EPA continuously refers to an alternative water source, how can your refer to it if you don’t know where the water source will come from. Also, it has been stated several times, that once the Buyout is complete, all public services will cut off from the Tar Creek area and residents who remain. Also, please take into consideration the Ozark Cavefish, it is on the endangered species list and is an aquatic receptor. Due to the karst topography within Ottawa County, contamination to ground water could likely affect this endangered species.

Response: Due to the uncertainty as to the type of water supply systems that will remain after completion of the State’s relocation, the method for supplying the water will be determined during the

Remedial Design. However, the alternative methods may include importing bottled water, providing for home treatment systems, etc.

EPA acknowledges the potential presence of the Ozark Cavefish. The actions taken as part of the OU4 remedy will result in the removal of source material from the site and would be expected to improve any potential habitats. Source material will be eliminated from the distal areas of the site in Phase 1 which will remove sources of contamination from approximately 80% of the site. Based on available information, the Ozark cavefish is not found within the Site, however, as part of this ROD, EPA will conduct a hydrogeological study that could be used to evaluate specific locations where habitat may exist outside the boundaries of the site. EPA will coordinate with the Fish and Wildlife Service to ensure that any concerns about impacts to critical habitats are addressed.

Comment 22: The Proposed Plan does not clearly address how decisions will be made about what is to be done, how it will be done or what the cleanup standards will be. What remediation activities will be used to ensure the proper clean up procedures? The Proposed Plan does not clearly address how the cleanup process will be conducted.

Response: Cleanup standards (*i.e.,* remedial action objectives and remediation goals) are identified in Section 15.1 of the ROD (Remedial Action Objectives for the Site) and are the same as those presented in the Proposed Plan. The approach to the remedy is discussed in this ROD and primarily consists of implementing different phases of the remedy over time. Each phase has distinct remedial elements and approaches that are outlined and discussed in detail. As cleanups are completed over time, confirmation sampling will be completed to verify that the remedy achieved remediation goals and remedial action objectives.

Comment 23: What is the priority basis that will be used to clean up source material in Tar, Lytle, Elm or Beaver Creeks?

Response: During Remedial Design, a priority system will be developed for all remedial actions and is defined to some degree by the phasing of the remedial elements as discussed in this ROD. Actions to address source materials in Site surface water systems are included in the early actions completed at the Site. Priorities among streams will probably be driven by those actions that can accomplish the greatest amount of risk reduction and overall environmental improvement in the least amount of time at a reasonable cost with the long-term permanent protection for the stream section in question. Of these in-stream actions, action in Tar Creek may be completed last because, until source materials in the Tar Creek watershed (but outside of the stream) are addressed, the watershed source materials will contribute to in-stream contamination. So it makes sense to address in-stream contamination last. In contrast, in other Site streams where there are no source materials in the watershed that could contribute to the recontamination of the stream, in-stream source materials may be addressed quickly and those in-stream materials will be given a higher priority than those in Tar Creek. Nonetheless, the in-stream contamination in Tar Creek will be addressed as part of Phase 1.

Comment 24: What is the method for stream remediation? Is it based on visual observation of source materials, sampling concentrations, or stream locations?

Response: Areas requiring source material to be excavated from streams will be based upon visual observation of source materials within the stream bed. However, following excavation, a sampling and analysis program will be implemented to verify that the excavated areas meet the remediation goals.

Comment 25: Will chat/source material be pulled out of the stream banks or riparian zones located near the water bodies? Has a buffer zone for the chat removal from the streams been established? Riparian zones should be cleaned up as well.

Response: Yes, source material will be excavated from stream beds and banks. Buffer zones have not been established for the site streams, but areas containing source material near the streams may be addressed in the interim with engineering controls to prevent recontamination of the streams.

Comment 26: Will geological studies be conducted to ensure that the repository cells/landfill is not constructed in a subsidence area? What citing criteria will be used? What type of liner will be used? Will there be a leachate collection system? Where will leachate and storm water go? Will there be long-term monitoring of groundwater and surface water?

Response: All necessary precautions will be conducted to ensure that the repositories are not installed in a subsidence area. On-site repositories will be constructed to accept Site source materials for final disposal. The repositories will cover an estimated 28 acres and will be capable of receiving an estimated 1,000,000 yd^3 of source materials, affected soils, and other Site-related materials such as wood, concrete, and miscellaneous debris. The liners for on-site repositories that are not built in areas of contamination shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-11-2(b) unless an alternative is approved by EPA consistent with OAC 252:515-11-2(c). The cover shall meet the substantive requirements of the ODEQ regulations at OAC 252:515-19-53(a) or an equivalent alternative as determined by EPA consistent with OAC 252:515-19-53(c). The requirements of OAC 252:515-19-53(a) include a barrier layer that is at least 24 inches of earthen material. The requirements also include the installation of an erosion layer above the barrier layer. The erosion layer is to be at least one foot of soil capable of sustaining plant growth. For cost estimating purposes, a clay liner, filter sand bed, and a soil cover are assumed although the actual construction will be determined in the Remedial Design. Upon closure, repositories will be contoured to promote drainage and revegetated.

Comment 27: The Plan needs a provision to allow for the processing of the fine tailings. We believe zinc and other metals can be extracted economically from this material. This would have a large economical benefit for this area and be an alternative to injecting this material back into the mines.

Response: Fine tailings will be injected or covered in place. The fine tailings may be consolidated to reduce the footprint of the final cover. Additional processing could be completed prior to the implementation of these actions as long as the processing does not compromise the implementation of the remedy.

Comment 28: The plan says EPA will encourage chat sales. It is impossible to encourage sales by regulating a product as a "hazardous waste" when in fact it has less than 400 ppm lead (washed chat). If you truly want to encourage chat sale I would suggest you open up more communication with the companies that sell chat. Real communication, not just one or two conversations on the subject.

Response: While chat that contains lead at concentrations of less than 400 parts per million does not exceed EPA's remediation goals for the Site, that does not mean that use of such chat is risk free. Lead is a dangerous hazardous substance, and exposure to lead should be avoided. *See* "Preventing Lead Poisoning in Young Children, A Statement by the Centers for Disease Control" (October, 1991). Under the selected remedy, only those uses of Site chat identified in the ROD are allowed because those are the uses that EPA has determined to be safe. Please also see EPA's response to Comment 16 in Section 23.1 (Summary and Response to Local Community Concerns).

Comment 29: The remedy the Tribe supported was more explicit at aggressively controlling the sources that contaminate our ground and surface waters, while maximizing future unrestricted use of surficial lands. Specifically, threats associated with releases from surficial wastes including those associated with repositories would generally have been eliminated in our proposed remedy. Our experts tell us that a more aggressive cleanup (to pre-mining conditions) is necessary because our future uses of the land include using reservation resources as they were used prior to mining - the Quapaw Tribe has never given up its rights to use our resources as originally intended.

Response: In developing its remediation goals for OU4, EPA Region 6 considered the Ecological Remediation Goals developed for Cherokee County, Kansas by Region 7. The Region 7 analysis recommended a range of values for lead in soil that would be protective for exposed terrestrial wildlife. EPA Region 7 used these remediation goal ranges when it selected the remediation goals for the Cherokee County, Kansas, Site in the Amended Record of Decision dated September 29, 2006. Based on the

similarity of the ecologies in the two areas (Region 7 Draft Ecological Preliminary Remediation Goals, Cherokee county Superfund Site (July 14, 2006) Memorandum from Jon Rauscher, May 24, 2007), it is appropriate to use the same ranges for OU4 remediation goals. The remediation goal for lead at Tar Creek is 500 mg/kg because that is within the range recommended in the Region 7 report, and because EPA Region 6's Baseline Human Health Risk Assessment for Operable Unit 2 (Residential Areas), based on the Integrated Biokinetic Uptake Model (IEUBK), found that 500 mg/kg was protective of human health. Moreover, EPA has found that when lead at the site is remediated to 500 mg/kg, the other Site metals are also remediated to safe levels because the metals are almost invariably found in proportionate concentrations. In short, based on the Region 7 report, we have selected remediation goals that are protective of the environment, and, based on the Region 6 study, these goals are also protective of human health. The selected remedy identified in this ROD should provide protection for the subsistence lifestyle at the conclusion of the remedy. The removal of source materials, transition zone soils, and soils which underlie source material above the action levels and the implementation of soil rebuilding and grading will result in levels of COCs well below the action level and may even achieve background concentrations in some settings.

Comment 30: The Tribe continues to be concerned about the weight that will be given to various costs in the ultimate design of the preferred remedy. We are still concerned that a pure cost benefit approach in evaluating whether or not to cap or remove mill ponds - without considering the other eight criteria of the NCP - could subvert the intent of the NCP by failing to "take a hard look" at cumulative affects of addressing mill ponds with a myriad of small subprojects.

Response: EPA does not agree that a pure cost benefit approach was implemented. The EPA implemented a detailed analysis process with respect to the nine criteria prescribed by the National Contingency Plan (NCP) (40 CFR Part 300), before a remedy selection decision was made. Under the NCP, cost can only be considered in selecting a remedy from among protective alternatives. The remedy selection process requires that alternatives must be demonstrated to be protective and ARAR-compliant (or justify a waiver) in order to be eligible for consideration in the balancing process by which the remedy is selected. This sequence of steps ensures that the selected remedy will be protective of human health and the environment. Cost is a relevant factor for consideration as part of the selection of the remedy from among protective, ARAR-compliant alternatives.

The detailed analysis of alternatives consists of the analysis and presentation of the relevant information needed to allow decision-makers to select a site remedy. (It is not the decision-making process itself.) During the detailed analysis, each alternative is assessed against each of the nine criteria. The analysis lays out the performance of each alternative in terms of compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost. The assessment of overall protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness and compliance with ARARs. State and community acceptance also are assessed, although definitive assessments of these factors cannot be completed until the public comment period on the draft RI/FS and proposed plan is completed.

After making the individual criterion assessments for each alternative, the alternatives are compared to each other. This comparative analysis identifies the key tradeoffs (relative advantages and disadvantages) among the alternatives with respect to the nine criteria. The purpose of this comparative analysis is to provide decision-makers with sufficient information to balance the trade-offs associated with the alternatives, select an appropriate remedy for the site and demonstrate satisfaction of the CERCLA remedy selection requirements.

Comment 31: It is necessary that the EPA clarify in the Proposed Plan that the CERCLA protections and incentives currently applied to chat sales will remain in place for the duration of chat sales.

Response: As reflected in the OU4 ROD, EPA will coordinate with the Department of Justice to provide liability protection for chat/land owners to help allay the concern of some chat owners regarding potential future liability arising from the sale and transport of chat to off-site locations.

Comment 32: The EPA should be aware - this is a point the Quapaw Tribe has tried to make to the EPA on many occasions - that any additional requirements and /or potential liability burden placed on chat sellers/processors, will severely reduce or eliminate the economic viability of the already marginal market for chat. The EPA should consider additional aid to restricted Indian chat sellers/processors that would alleviate these burdens by providing financial incentives to compensate for these burdens, or by transferring them to others. For example, providing technical assistance for complying with the Chat Rule and the Off-Site Rule, and providing Human Health Risk Assessment analyses for proposed non-transportation uses for chat. The EPA should continue to fund the disposal of chat fines that may be produced by chat particle sizing operations. The EPA should also consider subsidizing the transportation of chat beyond a pre-defined radius from the Site.

Response: Chat sales are part of the CERCLA remedy. As part of the selected remedy under the OU4 ROD, EPA will facilitate activities to support chat sales that will include the following:

a) EPA will work with the DOI to facilitate sales of Indian-owned chat.
b) EPA will present a workshop to assist chat/land owners and sellers with chat sales.
c) EPA will provide sample chat sale agreements and site operating plans to chat/land owners and chat processors.
d) EPA will answer questions about the Chat Rule.
e) EPA will provide technical review to any requests for chat use other than chat mixed in asphalt for federal transportation projects.
f) EPA will conduct a risk assessment on chat materials that exceed the SPLP and proposed for use in concrete as specified in the Chat Rule to support the ultimate sale of the chat.
g) EPA will coordinate with DOJ to provide liability protection for chat/land owners.

As a consequence of EPA's selection of chat sales as a part of the remedy for the Tar Creek Superfund Site, the BIA, with the assistance of other agencies of the DOI, will manage and administer the following (*DOI letter dated September 28, 2007, from Mr. L. Michael Bogert to Regional Administrator Richard E. Greene*):

a) Perform engineering ownership determinations, cadastral surveys, and appraisals, if needed;
b) Outreach and communication with the Indian owners of restricted chat and land regarding chat sales and surface leasing;
c) Appraisals of the fair market value of restricted chat and surface leases and provision of copies thereof to the Indian chat owners and land owners;
d) Necessary tasks associated with the review and possible approval of chat sales contracts and business site leases,
e) Quantitative analysis of chat removed from Indian-owned restricted chat piles for production verification purposes;
f) Tasks associated with the accounting of funds and distribution of proceeds from the sale of restricted chat to Indian owners;
g) Logistics associated with competitive or negotiated sales of Indian-owned restricted chat;
h) Assistance, as required in negotiations between Indian owners of restricted chat and potential chat purchasers;
i) Coordination of sales and other issues with the relevant offices of Federal, State, and Tribal governments; and
j) Review and enforcement of sellers' compliance with chat sales agreements and volumetric recording of chat sales.

The requirements for on-site and off-site use of Site chat are explained in ROD Section 19.2.2 (Environmentally Acceptable Chat Use). Lastly, there are no plans by EPA to subsidize the transportation of chat.

Comment 33: EPA should incorporate the best management practices established under the Pilot Project for the Sale of Indian-Owned Chat at ARARs for all chat sales. EPA should incorporate into the Proposed Plan the requirements developed by the DOI and the EPA in consultation with the State and the Quapaw Tribe and be made enforceable for the processing and transport of all chat, irrespective of ownership. Those standards developed as part of the Pilot project for the Sale of Indian Owned Chat are reasonable and protective of human health and the environment. EPA's enforcement of its own end use Chat Rule, 40 C.F.R Part 278, and the Off-Site Rule, 40 C.F.R. Part 300.440, is necessary and the processing and transport of chat prior to end use must also be regulated.

Response: Only cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law can be ARARs, so the practices established under the Pilot Project do not qualify. Under the ROD, EPA has established standards for environmentally safe uses of Site chat. These standards can generally be found in ROD Section 19.2.2 (Environmentally Acceptable Chat Use) and these standards include an expansion of the provisions of the Chat Rule to cover Site chat use. Section 19.2.2 also explains that EPA will determine the acceptability of off-site facilities for the receipt of Site chat. As explained in Section 19.2.2, since chat washing facilities will continue to operate independent of EPA's OU4 remedial actions, the State's general permit provisions and other State, Federal and local regulations apply with the force of law (to the extent that they did prior to the ROD) with respect to all on-Site chat washing facilities under these jurisdictions, respectively. EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat processing operations. Please see the ROD's Glossary of Terms where EPA has defined and identified general components of Best Management Practices.

Comment 34: EPA must act as lead agency for oversight of all chat sales.

Response: Chat sales are a pre-existing activity at the Site. To ensure that chat sales continue at the Site and to further promote the environmentally protective use of chat, EPA will facilitate activities to support chat sales and will work with its Federal, State and Tribal partners to ensure that all Site chat is managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble. See response to Comment 32 in this section.

Comment 35(a): Forced Sales or other Disposition of chat during Phase 2: Will the EPA oversee the Implementation of the 5 year plan and will the EPA pay compensation to the chat owners if it removes the chat?

Comment35(b) Under the Proposed Plan, upon receiving a Notice from the EPA, it is not clear whether a chat owner is able to develop a 5 yr plan with EPA under which the owner sells chat during Phase 2, and whether such sale would be considered an "authorized" or "ordered" sale by EPA.

Response: Owners of chat and/or the land that chat is present on in distal areas will be contacted, and where these owners agree, chat will be excavated and released to a chat processor or future processing location located in a previously contaminated area of the Site, injected in mine workings, or disposed in an on-site repository. If the owners will not release the chat for excavation and disposition, they will be asked to provide a plan and schedule for final disposition that is consistent with this ROD**.** Disposition under the owner's EPA-approved plans must be completed within five years (unless the chat is located in streams in which case, owners will have only one year to complete disposition under and EPA-approved plan). If owners do not provide plans that are acceptable to EPA, EPA may take legal action.

The remedial activities identified for Phase 2 will be conducted in the final five years of the Remedial Action to maximize active chat sales. Until a chat owner is notified (or effectively notified) that EPA intends to excavate the owner's chat pile or chat base as provided in the OU4 ROD, EPA expects that chat owners will continue to sell or use their chat subject only to the provisions in Section 19.2.2 (Environmentally Acceptable Chat Use) of the ROD. EPA will evaluate the progress of chat sales at least every five years. Chat piles and chat bases that remain and that are unmarketable after 10 years will be

identified and evaluated to see if it can be sold profitably. This determination will be made with input from the chat/landowners, appropriate Tribal representatives, and the commercial operators.

Comment 36: Would such sales be considered a "remedial activity" under the ROD at that point is not evident.

Response: Yes. See response to Comment 32 in this section.

Comment 37: If the Chat owner is a restricted Indian, the Proposed Plan does not address whether the terms set forth in the 5 year plan would be enforced by EPA or DOI.

Response: As part of each five-year review, EPA will evaluate the progress of chat sales. Chat piles and bases remaining after 10 years will be evaluated for commercial viability. This determination will be made using input from the chat/land owners, appropriate Tribal representatives, and the commercial operators. Unmarketable chat piles and bases will be excavated, transported to an on-site chat processor and released to that processor, or it will be disposed in an on-site repository. Where chat/land owners will not release the unmarketable chat, they will be asked to provide a plan, including a schedule, for its final disposition consistent with this ROD. Scheduled disposition under the owners' plans must be completed within five years. If EPA finds that the plan or schedule is unacceptable, EPA may take legal action. Where Indians are involved, EPA will coordinate with DOI as explained in ROD Section 19.2.2 (Environmentally Acceptable Chat Use).

Comment 38: In this situation where the owner of the chat does not own the land on which the pile is located, it is not clear that EPA will facilitate or otherwise order cooperation of the land owner.

Response: This comment concerns remedy implementation and not remedy selection. There are many chat ownership and land ownership scenarios at OU4. Each situation is fact specific and will be addressed during remedy implementation. Section 19.2.2 of the ROD provides additional information on how EPA will work with chat/land owners.

Comment 39: Chat contains hazardous substances under the CERCLA, but it also currently has a market value and is owned by individuals. DOI does not support EPA's disposal or removal of the chat during Phase 2 (discussed at pages. 3-4) without payment of just compensation to the chat owners. Any Notice issued by EPA to Indian chat owners that result in EPA's removal of the chat must include plans for payment to the Indians. We recommend that all Alternatives in the Proposed Plan be amended to include such compensatory payments.

Response: EPA plans to remove only unmarketable chat under the Phase 2 procedures that you reference. No payment will be made since only unmarketable (i.e., chat that cannot be sold) will be removed. Before EPA makes a determination that the chat cannot be sold, it will evaluate input from the chat/land owners, appropriate Tribal representatives, and the commercial operators. See ROD Section 4 (Description of the Selected Remedy); and see EPA's responses to comments 36a and 36b above.

Comment 40: DOI supports EPA's funding and activities proposed for "Encouraging Chat Sales." While EPA must be lead enforcement agency at the Superfund Site, DOI supports EPA's funding of HAZWOPER training and enforcement of the Off-site rule, as well as the funding of various entities for additional, concurrent oversight of chat operations consistent with their respective roles as sovereign entities. The Proposed Plan provides funding to the Quapaw Tribe and the ODEQ for oversight of chat operations. It does not, however, clarify whether the Tribe and/or State will conduct oversight of operations on Indian-owned piles, non-Indian owned piles, the commingled piles, or all types of chat piles.

Response: DOI provided clarification on this comment (*DOI letter dated September 28, 2007, from Mr. L. Michael Bogert to Regional Administrator Richard E. Greene*). The letter notes that BIA, with the assistance of other agencies of the DOI, will manage and administer the following:

a) Perform engineering ownership determinations, cadastral surveys, and appraisals, if needed;

b) Outreach and communication with the Indian owners of restricted chat and land regarding chat sales and surface leasing;
c) Appraisals of the fair market value of restricted chat and surface leases and provision of copies thereof to the Indian chat owners and land owners;
d) Necessary tasks associated with the review and possible approval of chat sales contracts and business site leases,
e) Quantitative analysis of chat removed from Indian-owned restricted chat piles for production verification purposes;
f) Tasks associated with the accounting of funds and distribution of proceeds from the sale of restricted chat to Indian owners;
g) Logistics associated with competitive or negotiated sales of Indian-owned restricted chat;
h) Assistance, as required in negotiations between Indian owners of restricted chat and potential chat purchasers;
i) Coordination of sales and other issues with the relevant offices of Federal, State, and Tribal governments; and
j) Review and enforcement of sellers' compliance with chat sales agreements and volumetric recording of chat sales.

EPA will facilitate activities to support chat sales that will include the following:

a) EPA will work with the DOI to facilitate sales of Indian-owned chat.
b) EPA will present a workshop to assist chat/land owners and sellers with chat sales.
c) EPA will provide sample chat sale agreements and site operating plans to chat/land owners and chat processors.
d) EPA will answer questions about the Chat Rule.
e) EPA will provide technical review to any requests for chat use other than chat mixed in asphalt for federal transportation projects.
f) EPA will conduct a risk assessment on chat materials that exceed the SPLP and proposed for use in concrete as specified in the Chat Rule to support the ultimate sale of the chat.
g) EPA will coordinate with DOJ to provide liability protection for chat/land owners.

The Proposed Plan estimated cost included a list of activities related to chat sales and costs associated with those activities, in the summary of remedial alternatives. EPA has determined since the Proposed Plan was issued that Hazardous Waste Operations and Emergency Response Standards (HAZWOPER) training will not be required at chat processing/handling operations since these activities are already covered under the applicable Mine Safety and Health Administration (MSHA) standards that are already in effect for these businesses.

Comment 41: EPA must authorize, implement and oversee all aspects of the remedy at the Tar Creek Superfund Site including chat sales, the key component of the proposed remedy. The EPA's assumption of such responsibilities is in accordance with the trust responsibility of the United States Government, (including EPA) to individual Indians owning land, chat or other resources located within the Tar Creek Superfund Site.

Response: See response to Comment 32.

Comment 42: EPA must bear all costs of such implementation and oversight, including but not limited to, the establishment of environmental compliance standards, environmental monitoring provided by or funded by the United States government, any enforcement activities, compliance, and certifications required by EPA's offsite disposal regulations. Nothing, however, precludes EPA from seeking cost-recovery for such implementation and oversight against any potentially responsible parties.

Response: Rather than spend Superfund money on remedial action, EPA has a longstanding policy to pursue "enforcement first" throughout the Superfund cleanup process. See Suarez, J.P., "Enforcement First for Remedial Action at Superfund Sites" (September 20, 2002). Existing EPA guidance emphasizes that a major component of the "enforcement first" policy is that potentially responsible parties (PRPs)

should conduct remedial actions whenever possible. See "Negotiation and Enforcement Strategies to Achieve Timely Settlement and Implementation of Remedial Design/Remedial Action at Superfund Sites," OSRE (June 17, 1999); and see "Guidance on CERCLA Section 106(a) Unilateral Administrative Orders for Remedial Designs and Remedial Actions," OSWER Dir. #9833.0-1a (Mar. 7, 1990). EPA prefers to achieve PRP-lead cleanups through settlements. Under such settlements, PRPs may undertake certain remedial action activities at a Superfund site and pay EPA for its work, including the type of work that the commenter describes. EPA intends to seek such a settlement regarding remedial design and remedial action for OU4.

Comment 43: Alternative 5, buyout, is the State's preferred alternative. Buyout is the key to the holistic solution; buyout is not included in EPA's preferred alternative (Alternative 4). Over the past few months, the State has provided appropriate and compelling justification for buyout. See correspondence to EPA Region 6 dated April 16, June 11, July 2, and September 21, 2007, attached and made a part of this administrative record. Although DEQ has had numerous meetings, telephone calls, teleconferences, and discussions with EPA regarding aspects of the Proposed Plan, EPA did not fully consider buyout as an alternative.

Response: Based on public comments, the comments of the Quapaw Tribe, the comments of the State, and facilitated by the passage of the Water Resources Development Act of 2007 (WRDA), EPA reevaluated the preferred alternative that it released to the public in the Proposed Plan. Instead of the preferred alternative—Proposed Plan Alternative 4, EPA selected a modified Alternative 5 which includes relocation and an extended timeframe for chat sales.

Comment 44: The National Contingency Plan (NCP) states that the "purpose of the remedy selection process is to implement remedies that eliminate, reduce, or control risks to human health and the environment" Toward that end, the stated "national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste.

Response: Comment noted.

Comment 45: It should be noted that "protection of the human health" is at the top of a list of many more criteria beyond "cost", which appears near the bottom of the list.

Response: Under the NCP, cost can only be considered in selecting a remedy from among protective alternatives. The remedy selection process requires that alternatives must be demonstrated to be protective and ARAR-compliant (or justify a waiver) in order to be eligible for consideration in the balancing process by which the remedy is selected. This sequence of steps ensures that the selected remedy will be protective of human health and the environment. Cost is a relevant factor for consideration as part of the selection of the remedy from among protective, ARAR-compliant alternatives. As explained in ROD Section 20.3 (Cost Effectiveness), the selected remedy is cost effective. It is also the least expensive of the protective remedies, measuring present value.

Comment 46: The DEQ is unclear as to EPA's acceptable uses of chat in non-transportation/non-construction/non-encapsulation activities. Is there a process to determine if other uses are acceptable? If so, please clarify.

Response: Under this ROD, only certain non-transportation uses of Site chat described in the Chat Rule preamble and the preamble-referenced fact sheet would be allowed. Specifically, under this ROD, Site chat used in non-transportation projects could only be used in cement and concrete non-residential construction projects as described in the Chat Rule preamble, and in applications that encapsulate the chat as a material for manufacturing a safe product or as part of an industrial process (*e.g.*, glass, glass recycling) where all waste byproducts are properly disposed, as described in the June 2007 fact sheet. In addition, non-transportation cement or concrete project material in question must, on a case-by-case basis, pass one of the two evaluation methods described in the Chat Rule preamble guidance. The two evaluation

methods concern testing the material using the Synthetic Precipitation Leaching Procedure, or having a State environmental agency or EPA conduct a site specific risk assessment with a public comment period. The following enumerated paragraphs explain how the two Chat Rule preamble evaluation methods will be used under the ROD:

(1) If Synthetic Precipitation Leaching Procedure (SPLP, EPA SW-846 Method 1312) tests conducted on the proposed material incorporating chat show that concentrations in the leachate do not exceed the National Primary Drinking Water Standards for lead of 0.015 mg/l and cadmium of 0.005 mg/l and the fresh water chronic National Recommended Water Quality Criterion for zinc of 120 µg/l then the chat use in question is acceptable under the ROD.

(2) If EPA (or a State environmental Agency, if it chooses to do so) has determined, based on a site-specific risk assessment and after notice and opportunity for public comment, that leachate from the proposed material incorporating chat will not cause an exceedance of the National Primary Drinking Water Standards Maximum Contaminant Level (MCL) for lead of 0.015 mg/l and cadmium of 0.005 mg/l in drinking water sources, and the National Recommended Water Quality Criteria for zinc of 120 µg/l in surface waters then the chat use in question is acceptable under the ROD.

There are certain uses of chat that EPA generally believes will pass one or the other of these evaluation methods, and these uses include applications that encapsulate chat as a material for manufacturing a safe product or as part of an industrial process (e.g., glass, glass recycling) where all waste byproducts are properly disposed, however, the evaluations would still have to be performed on a representative sample of the chat-containing material in question.

Comment 47(a): The DEQ is concerned that implementation and impact of the off-site rule could make asphalt mixing plants, trucks and highway sites "facilities" under CERCLA, thereby inhibiting the sale of chat. The impact of the implementation of the off-site is unclear.

Comment 47(b): The State is concerned that as asphalt mixing facility, the trucks that then haul the asphalt/chat mixture and/or an entire highway system would become a "facility" under CERCLA for purposes of the Off-Site rule. This scenario would effectively shut down the sale of Chat in Oklahoma. EPA should clarify the issues regarding using chat on highways as well as other locations which might be determined to be facilities under CERCLA.

Response: Section 121(d)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9621(d)(3), applies to any CERCLA response action involving the off-site transfer of any hazardous substance, or pollutant or contaminant (CERCLA wastes). That section requires that CERCLA wastes may only be placed in a facility operating in compliance with the Resource Conservation and Recovery Act (RCRA) or other applicable Federal or State requirements. That section further prohibits the transfer of CERCLA wastes to a land disposal facility that is releasing contaminants into the environment, and requires that any releases from other waste management units must be controlled. These principles are interpreted in the Off-Site Rule, set forth in the National Contingency Plan (NCP), at 40 CFR 300.440. The purpose of the Off-site Rule is to avoid having CERCLA wastes from response actions authorized or funded under CERCLA contribute to present or future environmental problems by directing these wastes to management units determined to be environmentally sound. See 58 FR 49200, 49201 (September 22, 1993).

EPA is presently conducting a pilot project with the U.S. Department of the Interior. Under this pilot project, DOI is facilitating the commercial sale of chat from certain restricted Indian allotments in order to determine the efficacy of these sales in ridding OU4 of chat. Since the pilot project is being conducted as part of a CERCLA response action, it is subject to the Off-site Rule. Accordingly, before any of the chat sold could be taken to an off-site facility (in this case an asphalt mixing plant), the EPA had to determine that the facility was acceptable within the meaning of the Off-site Rule. EPA's acceptability determination did not hinder the sale of chat under the pilot project; consequently, we do not foresee that application of the Off-site Rule will be a hindrance to chat sales as the commenter suggests. In short, all asphalt mixing facilities using Site chat would require an acceptability determination under the Off-site Rule, but the results of our pilot program show that this is not a problem for chat users or sellers.

Highway sites would not be considered "facilities" under the rule because once wastes have been treated off-site to certain levels, they cease to be considered CERCLA wastes and are no longer governed by the Off-site Rule. *See* 58 Fed. Reg. 49200, 49203 (September 22, 1993). For the type of CERCLA waste at issue (*i.e.,* chat) the CERCLA waste has to be treated to levels that substantially reduce the mobility, toxicity, or persistence of the wastes. *See* 58 Fed. Reg. at 49203. Thus an acceptability determination is not required for the chat once it has been bound in asphalt, so a highway site (*e.g.,* a road using chat mixed with asphalt) would not be a facility for which an acceptability determination would be needed under the Off-site rule.

When CERCLA wastes are transferred off-site, intermediate facilities wishing to store CERCLA waste must be acceptable under the Off-site Rule. *See* 58 Fed. Reg. 49203. Solely for purposes of interpreting and implementing the Off-site Rule, "storage" in this context does not include the transport of CERCLA waste (in a truck for example), and it also does not include the short-term holding of CERCLA waste when that holding occurs in the normal course of transit. For example, the holding by a chat user of a shipment of chat for ten days or less at a railroad spur, staging area, or similar place, would be viewed as part of the transportation process rather than as "storage," so that the chat user's temporary holding place is not subject to the Off-site Rule.

Comment 48: The inclusion of the chat rule, its preamble and the offsite rule as requirements for the beneficial reuse of chat at the Oklahoma Tar Creek Superfund Site would create disparity in the sale of chat in the Tri-State Mining District.

Response: See response to Comment 32.

Comment 49: The EPA Region 6's requirements are a disincentive to the beneficial reuse of chat in Oklahoma since the impact of the off-site rule would classify various chat sellers and users as owners under CERCLA and the property on which the chat is mixed would become a facility under CERCLA, thereby passing Superfund liability on to the very people who are trying to beneficially reuse the chat. These requirements are diametrically opposed to EPA's stated objective of addressing chat through beneficial reuse.

Response: There is no disincentive in encouraging the safe and beneficial use of chat from the Tri-state mining district, located in parts of Oklahoma, Kansas and Missouri. The established criteria presented in the rule involve chat that is located in the Tri-State mining district. To ensure that Site chat sales continue and that chat is used in a fashion that is protective of human health and the environment, all Site chat would be managed according to the criteria provided in the Chat Rule, 40 CFR Part 278, and its preamble. The remedy selected in this ROD includes these Part 278 waste management criteria. This means that we are including both the regulations that apply to transportation construction projects and the preamble guidance that applies to non-transportation, non-residential projects as requirements under the selected remedy. In addition, only the uses described in the preamble (including EPA's June 2007 fact sheet; EPA530-F-07-016B) and the transportation construction project uses described in 40 CFR Part 278 will be allowed for Site chat under this ROD.

Comment 50: EPA's Proposed Plan, incorporating the off-site rule, may be violative of the Commerce Clause of the U.S. Constitution (USCA Const. Art 1, 8, cl.3) and outside the scope of EPA's authority. Restricting the sale and use of chat in the Oklahoma area of the Tri-State Mining District while not restricting the sale and use of chat in the Missouri and Kansas areas of the Tri-State Mining District Places different standards upon the residents and businesses of the area. The economic endeavor of selling chat, mixing it with asphalt and using it on roadways off of the Superfund site substantially affects interstate commerce. EPA's Proposed Plan restricts only Oklahoma's activities. The activity in Kansas, Missouri and Oklahoma should be regulated in the same way.

Response: EPA disagrees with this comment. CERCLA is constitutional under the Commerce Clause, and EPA's selected remedy for OU4 is authorized by CERCLA. The remedy is authorized by CERCLA because it is consistent with the NCP.

In *U.S. v. Lopez*, the Supreme Court held that the Commerce Clause empowers Congress to regulate: (1) channels of interstate commerce; (2) instrumentalities of and persons or things in interstate commerce; and (3) intrastate activities that substantially affect interstate commerce. *United States v. Lopez*, 514 U.S. 549, __ , 115 S. Ct. 1624, 1629-30, 131 L. Ed. 2d 626, ___ (1995). CERCLA reflects Congress's recognition that both on-site and off-site disposal of hazardous waste threaten interstate commerce. *United States v. Olin Corp.*, 107 F.3d 1506, 1511 (11th Cir. 1997). CERCLA does not violate the Commerce Clause. *See id.*

CERCLA Section 104(a)(1), 42 U.S.C. 9607(a)(1), provides in pertinent part that

> [w]henever (A) any hazardous substance is released or there is a substantial threat of such a release into the environment. . ., which may present an imminent and substantial danger to the public health or welfare, the President is authorized to act, consistent with the national contingency plan, to remove or arrange for the removal of, and provide for remedial action relating to such hazardous substance, pollutant, or contaminant at any time (including its removal from any contaminated natural resource), or take any other response measure consistent with the national contingency plan which the President deems necessary to protect the public health or welfare or the environment.

There is a release at the Site, and, as documented in EPA's Baseline Human Health Risk Assessment and other Administrative Record documents, there is an imminent and substantial danger to the public health. So it is appropriate that EPA act, consistent with the NCP. As stated in the preamble to the NCP (55 Fed, Reg. 8666), the overarching mandate of the Superfund program is to protect human health and the environment from the current and potential threats posed by uncontrolled hazardous waste sites. This mandate applies to all remedial actions and cannot be waived. Consistent with the program expectations, the mandate for remedies that protect human health and the environment can be fulfilled through a variety or combination of means. These means include the recycling of contaminants. *See* 40 CFR Section 300.430(e)(9)(iii)(D)(*1*) (This NCP section was purposely revised to indicate that recycling is an acceptable means of accomplishing reduction of toxicity, mobility or volume as mandated by CERCLA.) 55 Fed. Reg. 8666. Under the selected remedy in the OU4 ROD, chat is recycled through the various transportation and non-transportation uses described in the Chat Rule preamble that EPA has determined are acceptable under the ROD. In order to ensure that chat use is environmentally acceptable (*i.e.,* to ensure that recycling is actually occurring), EPA has selected, as part of its remedy for the Site, the chat use requirements described in ROD Section 19.2.2 (Environmentally Acceptable Chat Use).

In short, CERCLA passes muster under the Commerce Clause, CERCLA Section 104 authorizes actions that are consistent with the NCP, the NCP authorizes recycling as a means to reduce toxicity, mobility or volume, and the selected remedy includes chat recycling as part of the remedy. To ensure that recycling is actually occurring, EPA has selected, using its NCP procedures, the chat use requirements described in ROD Section 19.2.2.

Comment 51(a): The DEQ is troubled that EPA's preferred alternative does not clearly identify whether all residents of the Tar Creek area, Indian and non-Indian alike, will receive a release of liability and contribution protection from EPA for the commerce and beneficial reuse of chat.

Comment 51(b): In discussing Alternative 4 on page 19 of the Proposed Plan, EPA states that "EPA anticipates that Indian-owned chat sales will be managed pursuant to an agreement between EPA and the DOI that will define roles and responsibilities. EPA can address the release of chat in accordance with CERCLA authorities in a manner that will benefit chat/land owners and the environment." Owners' fear of incurring CERCLA liability from the sale and transport of chat to off-site locations and references the St.

Joe Pile (on Indian land) wherein EPA provided a covenant not to sue and contribution protection under CERCLA in an agreement approved by the United States Department of Justice. EPA states that it plans to extend that practice upon request.

Comment 51(c): Not until some time later on page 20 are non-Indian chat landowners discussed. See paragraph 4. There is no mention of a covenant not to sue or contribution protection under CERCLA for non-Indian chat landowners

Response to 51(a), (b), and (c): While chat sales have occurred on and off Site for many years, EPA recognizes that chat sales could be impeded by owners' fear of incurring CERCLA liability to the United States or others arising from unanticipated adverse consequences associated with chat sales. To help allay the concerns regarding potential future liability arising from the sale and transport of chat to off-site locations during the Chat Sale Pilot Project, EPA entered into CERCLA administrative settlements with sellers of the St. Joe Pile, providing a covenant not to sue from EPA for sales made in compliance with the terms of the agreement, and providing contribution protection pursuant to CERCLA § 113(f)(2), 42 U.S.C. § 9613(f)(2). These agreements were approved by the U.S. Department of Justice. Although the Agency wishes to make clear that these agreements provide no protection from any liability already incurred on the basis of past acts or current status, the agreements appear to have successfully facilitated chat sales during the Pilot Project, and it is EPA's intention to extend that practice as chat is sold pursuant to the ROD, subject to coordination and approval with the Department of Justice.

Comment 52: The DEQ is hopeful that all owners of chat, Indians and non-Indians alike, will be treated equally under the law and would receive the same release of liability and contribution protection under CERCLA for the same chat related activities at Tar Creek. At a minimum, EPA must clarify the language so that all Oklahomans know what protections apply to all parties engaged in the commerce and beneficial reuse of chat.

Response: Under the remedy selected in the ROD, EPA will present a workshop to assist all chat/land owners and sellers with chat sales. The purpose of the workshop will be to inform the public regarding the requirements of ROD Section 19.2.2 (Environmentally Acceptable Chat Use).

Comment 53(a): The DEQ continues to believe that the site-wide hydrogeologic study discussed in the Proposed Plan needs to include a consideration of the pathway from the Boone to the Roubidoux. DEQ believes that EPA should cause "no harm", rather than "no further harm" to the groundwater and surface waters in the area.

Comment 53(b): The EPA hydrogeologic study proposal has not been fully developed. The Department has concerns with subaqueous disposal without data to evaluate the feasibility and environmental protection of the Boone and Roubidoux aquifers and the potential for increased acid mine drainage issues. Given the connectivity between the Roubidoux and Boone aquifer, the Roubidoux aquifer must be protected from injection of millions of cubic yards of the highest concentration, most leachable waste into the Boone aquifer. There also needs to be an understanding of any trends which may or may not be occurring over time with regard to COPCs and pH and how subaqueous disposal may impact or alter those trends and conditions. An understanding of flow directions, changes in COPC concentrations, and length of time for equilibration in the mine should be better developed. There also needs to be a concentration established that is acceptable or not acceptable for continued chat injection, and the possible affects of the increased (including short term) concentrations of COPC that may appear in springs and seeps should be addressed.

Response to comment 53(a) and (b): To the extent that it can be feasibly assessed, EPA is investigating the possible connection between the Boone and Roubidoux aquifers as part of an ongoing hydrogeological study that is being carried out apart from the selected remedy. In addition, the study will assess the potential for source material injected into the mines to cause harm to ground water and surface water.

Comment 54: The source of water used by chat operations that wash chat prior to use is also a concern to the Department. It is the Department's understanding that there are no discharges allowed from chat washing operations and the Department supports that position. Chat operations which wash chat should also have source water regulated. Stream water should not be used for washing chat but acceptable sources may include water in subsidence features or ground water in areas where subaqueous disposal will occur.

Response: Chat washing facilities will continue to operate independent of EPA's OU4 remedial actions, the State's general permit provisions and other State, Federal and local regulations apply with the force of law (to the extent that they did prior to the ROD) with respect to all on-Site chat washing facilities under these jurisdictions, respectively. EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat processing operations.

Comment 55: The EPA should modify the component of the preferred Alternative that addresses waste material in streams. The Department does not support the use of installation of a flexible membrane liner as a remediation method. Instead, the Department recommends that EPA adopt the component of Alternative 8 that would completely remove in/near stream waste and integrate it into existing upland chat deposits as an early response.

Response: The use of flexible membrane liner is only proposed for those sections of a stream where it may be concluded that significant thicknesses of source materials may exist, and that excavation and removal of those materials may cause greater harm to the environment compared to the amount of risk reduction that would be accomplished. For example, if the amount of source material requiring excavation would result in bank slope stability problems or that the hydrodynamic of the stream would be altered such that instability problems would be expected to occur in other locations in the watershed, then a flexible membrane liner would be used. The hydrology model discussed in Section 19.2.3 will be used in the remedial design to identify areas that the use of a flexible membrane liner will provide the best engineering approach. Where the remedial design concludes that a liner should be used, a liner is expected to eliminate the direct contact exposure route and minimize or prevent any further harm to the environment.

Comment 56: Complete removal of waste material from in/near streams would greatly decrease the injury to the streams and their riparian corridor and would increase the recovery of fish, mussel and other aquatic biota in the streams. Further, EPA should consider the geomorphology of the streams. Streams in the area are often chat-choked and have been channelized. Items to consider include, but are not limited to, restoring meanders, identifying proper gradients and providing clean gravel if necessary to prevent headcutting conditions.

Response: EPA takes note of the comment and plans to include these stream reclamation concepts into a design approach (during the Remedial Design phase of the remedy) consistent with approaches that minimize increased storm water runoff or other damages caused by erosion.

Comment 57: Page 11, paragraph 2: This is very confusing statement - "High concentrations of lead are addressed under the preferred remedy identified in this Proposed Plan; however, the concentrations of lead are not so high as to be several orders of magnitude above levels that allow for unrestricted use and unlimited exposure. Therefore, the lead is not considered to be a principal threat under the NCP; consequently, there is not expectation under the NCP that the lead be treated." Does this mean that EPA doesn't have to address lead? What is the reason EPA is addressing lead if it doesn't have to?

Response: Under the NCP, lead at the site is not considered a principal threat waste, which are characterized as wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials, and high concentrations of toxic compounds (e.g. concentrations several orders of magnitude above levels that allow for unrestricted use and unlimited exposure) [(see 55 Fed. Reg. 8666, 8703 (March 8, 1990)]. The source material at the site is generally classified as a low level threat waste rather than a principal threat waste. If the lead at this Site was classified as a principal threat waste, the NCP has the expectation that the waste be treated. EPA's statement attempts to convey that because the waste is not a principal threat waste, the preference for treatment does not have to be met. This does not mean or imply that a

remedy to address the risk that lead presents to human health and the environment is not necessary or required.

Comment 58(a): Page 14, paragraph 1: The clean up levels for lead at the Tar Creek Site should be consistence with the Cherokee County KS clean up level of 400 mg/kg. The Sites are contiguous and clean up at the sites should occur at the same time with the same remediation goals.

Comment 58(b): Page 14 "box": Terrestrial Fauna: The clean up levels for lead at the Tar Creek Site should be consistent with the Cherokee County KS clean up level of 400 mg/kg. The Sites are contiguous and clean up at the sites should occur at the same time with the same remediation goals.

Response to Comments 58(a) and (b): In developing its remediation goals for OU4, EPA Region 6 considered the Ecological Remediation Goals developed for Cherokee County, Kansas by Region 7. The Region 7 analysis recommended a range of values for lead in soil that would be protective for exposed terrestrial wildlife. The Region 7 recommended soil remediation goals for lead ranged between 377 and 1,175 milligrams per kilogram (mg/kg). EPA Region 7 used these remediation goal ranges when it selected the remediation goals for the Cherokee County, Kansas, Site in the Amended Record of Decision dated September 29, 2006. Based on the similarity of the ecologies in the two areas (*see* cite to Toxicologist John Rauscher's Memorandum), it is appropriate to use the same ranges for OU4 remediation goals. The remediation goal for lead at Tar Creek is 500 mg/kg because that is within the range recommended in the Region 7 report, and because EPA Region 6's Baseline Human Health Risk Assessment for Operable Unit 2 (Residential Areas), based on the Integrated Biokinetic Uptake Model (IEUBK), found that 500 mg/kg was protective of human health. In short, based on the Region 7 report, 500 mg/kg is protective of the environment and based on the Region 6 study, it is also protective of human health.

Comment 59: Page 20, 3rd paragraph: Include a discussion about transition zone remediation including discussion about contamination outside the 50 foot transition zone identified in Proposed Plan. The entire extent of the transition zone should be remediated.

Response: EPA agrees. If concentrations of contaminants in the transitions zone soils exceed remediation goals, they will be addressed by the remedy. The 50-foot limit was an approximation or estimate based upon existing data, and it was used to develop a consistent approach and cost estimate for the remedial alternatives. Actual transition zones may be larger or smaller than fifty feet.

Comment 60: Page 34 paragraph 1: Explain how Alternative 8 will be more difficult to implement than alternative 4. When dealing with waste in streams EPA will need to get land owner approval to do any work on their land (removal or membrane placement) and EPA will need to coordinate with chat owners to move the chat out of the stream or to an existing pile.

Response: With respect to wastes found in streams, Alternatives 8 and 4 are not significantly different. Alternative 8 proposes to remove all source materials found in site streams through excavation while Alternative 4 and Alternative 5 (the selected remedy) utilize the same approach with the added flexibility that allows the selected remedy to address thick deposits of source materials in streams through the installation of a flexible membrane liner. EPA agrees that access to site streams to address source materials will have to be coordinated with local land owners and their permission will be sought.

Comment 61: The Federal Government is a fiduciary to the Quapaw Indian chat and land owners who may be significantly impacted by the Proposed Plan.

Response: The Department of the Interior generally takes the fiduciary role for the Quapaw with restricted interests at the Site. As explained in the ROD, EPA intends to coordinate with DOI on certain issues.

Comment 62: Any chat sale program must be credible and lawful under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), the applicable law governing this Superfund Site. Participants in any sales program must know that the program is officially approved and

adopted by the EPA as an integral part of the remedial plan, and that the lead agency with oversight of this National Priorities List Site is committed to the sales program for the long term.

Response: See response to Comment 32 in this section.

Comment 63: A successful chat sales program must be allowed to go forward for at least a 25-year duration, or for the sale of all chat at the Superfund Site, whichever comes sooner. It will take time for the market to absorb the chat, and the benefits of sales will be maximized if the market is given the chance to do so. Setting an artificial limit on sales duration will lead to substantial, additional remedial costs. Chat left unsold is chat which must be disposed of, injected, impounded, or contained at a potentially steep price, and with uncertain long-term environmental consequences. Chat that is sold for environmentally sound uses puts money into the Ottawa County economy, and does not have to be disposed of, injected, impounded, or contained.

Response: Comment noted. Under the ROD, the duration for chat sales was modified to continue for a period of 30 years.

Comment 64: Consistent with the pilot project for chat sales, the DOI supports the "EPA's intention to enter into CERCLA administrative settlements with sellers of chat, upon request." (See p.2). However, the DOI questions under what "appropriate circumstances" the EPA would grant such requests (p. 2, end of 8th para.). It is unclear from the Proposed Plan whether the EPA would grant such requests to chat sellers if it is determined that their chat purchaser is in compliance with the State's standard ARARs. It is also unclear what the chat purchaser will need to show in order to establish that it has obtained all applicable state permits and is in compliance with the EPA's Chat and Off-Site Rules. Liability protection for chat sellers is essential.

Response: The determination as to what circumstances are appropriate for EPA to enter into settlements is a fact specific implementation issue that will be addressed during the Remedial Design or Remedial Action phase of the remedial process. That is, it is not part of the ROD, but will be decided later, based on the specific situations involved, as the selected remedy is implemented. EPA will facilitate a number of activities to help chat owners and landowners better understand the requirements of ROD Section 19.2.2 (Environmentally Acceptable Chat Use). In particular, as part of the remedy selected in the ROD, EPA will present a workshop to assist chat/land owners and sellers with chat sales.

Comment 65: The EPA should explicitly authorize the sale of chat as a "remedial activity" under the CERCLA and establish standard chat processing and transport requirements, applicable to chat operations for Indian and non-Indian owned chat.

Response: Chat sales are part of the CERCLA remedy. EPA's ROD has various chat use requirements intended to ensure environmentally acceptable use of Site chat. *See* ROD Section 19.2.2 (Chat Sales and Environmentally Acceptable Chat Use).

Comment 66: The EPA does not have any current operational, processing or transport requirements with respect to non-Indian owned chat at the Tar Creek Superfund Site. Although not specifically mentioned in the Proposed Plan, the EPA apparently would prefer the DOI to establish such standards for Indian-owned chat and Indian lands. Consistent environmental protection standards must apply to all chat sales at the Site. Under current law, only the EPA can establish, mandate, and implement such uniform standards.

Response: Since chat washing facilities will continue to operate independent of EPA's OU4 remedial actions, the State's general permit provisions and other State, Federal and local regulations apply with the force of law (to the extent that they did prior to the ROD) with respect to all on-Site chat washing facilities under these jurisdictions, respectively. EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat processing operations.

Comment 67(a): The EPA's proposed approach is inadequate because, apart from the federal Clean Water Act and the State Surface Mining statutes, the State of Oklahoma does not have any "special" permitting or operational requirements or regulations specifically pertaining to the purchase, processing and transport of chat within a Superfund Site. The Proposed Plan considers the State's "regulations" to be ARARs for chat washing facilities and states.

Comment 67(b): It is unlikely that the State regulations would be applicable to the Indian lands and Indian-owned chat. As a result, the operational requirements necessarily developed by the DOI as part of the NEPA analysis would likely result in more costly practices for the Indian owned chat and activities located on Indian land. This will result in unfavorable conditions in the market for the Indian chat and land owners and may inhibit the sale of all or part of the 40 million tons of Indian-owned chat.

Response: Although EPA's Proposed Plan described the substantive requirements of certain State regulations as ARARs that was an inaccurate description. In fact, since chat washing facilities will continue to operate independent of EPA's OU4 remedial actions, the State's general permit provisions and other State, Federal and local regulations apply with the force of law (to the extent that they did prior to the ROD) with respect to all on-Site chat washing facilities under these jurisdictions, respectively. EPA will encourage local, state, and federal authorities to enforce Best Management Practices and Storm Water Pollution Prevention Plans for facilities on the Site to ensure environmentally protective chat processing operations. For more about this issue please see ROD Section 19.2.2 (Environmentally Acceptable Chat Use).

Comment 68: The State is seeking a holistic solution to Tar Creek and our view of this operable unit is consistent with that vision. We believe that all the actions, particularly buyout, are integral to solving the human health and environmental problems at the site. Buyout should be the first action completed and should not be held up during EPA's enforcement actions for RD/RA with PRPs. Buyout could be accomplished in the first three years and would protect at least two future generations from lead exposure.

Response: EPA has modified the remedy to include relocation as a component. This addition along with the extended timeframe of 30 years for chat sales, will reduce risk and will also reduce the contained source material footprints. This effort along with the combined efforts of our Federal and State partners, will one day achieve a holistic solution for the site.

Comment 69: We believe that the offsite rule and the incorporation of the chat rule, preamble and fact sheets could adversely impact chat sales and will create a disparity in chat sales in Region 6 and Region 7.

Response: EPA is marginally expanding the requirements of the Chat Rule so that they apply to all uses of chat from the Site, not just to chat used in federal transportation projects. Our best professional judgment is 90% of all chat that is taken from the Site and from Region 7 chat piles is currently used in federal transportation projects. Since chat users that provide chat for federal transportation projects must already meet the requirements of the chat rule, we estimate that EPA's ROD requirements (*see* ROD Section 19.2.2) will barely have an impact.

Section 121(d)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9621(d)(3), applies to any CERCLA response action involving the off-site transfer of any hazardous substance, or pollutant or contaminant (CERCLA wastes). That section requires that CERCLA wastes may only be placed in a facility operating in compliance with the Resource Conservation and Recovery Act (RCRA) or other applicable Federal or State requirements. That section further prohibits the transfer of CERCLA wastes to a land disposal facility that is releasing contaminants into the environment, and requires that any releases from other waste management units must be controlled. These principles are interpreted in the Off-Site Rule, set forth in the National Contingency Plan (NCP), at 40 CFR 300.440. The purpose of the Off-site Rule is to avoid having CERCLA wastes from response actions authorized or funded under CERCLA contribute to present or future environmental problems by directing these wastes to management units determined to be environmentally sound. See 58 FR 49200, 49201 (September 22, 1993).

Comment 70: Another consequence of Alternative 4 will be that the chat processors would be required to provide a remedy for the remaining chat bases and fine tailings impoundments at the conclusion of their operations since the chat processing operations will proceed well past the 20 year time frame of Alt 4. To include these closure costs into the sales price of chat will undoubtedly result in increase cost of chat, reduced processing rates and lower purchase prices to the chat owners. We believe that Alternative 4 may result in large volumes of chat remaining on site, imposing the lead hazards to the current area residents and their future generations for a long time to come and eventually this chat would have to be dealt with by a future remedial action. These circumstances would not occur in Alternative 5 since the chat base and fine tailings ponds of the chat processing operations would be dealt with by the remedy under its longer time frame the cleanup costs would be borne by the entities that originally created the hazards. Again Alternative 5 is superior to Alternative 4.

Response: As reflected in the Record of Decision for OU4, the timeframe for chat sales has been modified. Since residents facing the greatest risk of exposure will now be relocated, the EPA has extended the timeframe for chat sales an additional 10 years, from 20 years, to 30 years. Additional information on this modification is in ROD Section 4.0 (Description of the Selected Remedy).

Comment 71: Both alternatives assume early 10% of the newly created fine tailings from chat washing will be dealt with by the remedy. The bulk of the newly created fine tailings are expected to be injected into the mine workings by the chat washers in a closed loop system. The closed loop system utilizes mine water pumped from the mines to wash the chat and dispose of the fines by gravity feed back into the mine workings. This system is currently not working, reportedly due to failure of the down-hole water supply pump that is located too close to the fines injection well. If this system is not used by the chat washers as planned (or if injection is rejected by the hydrogeologic study), the consequence is that the remedy may underestimate the volume of newly washed fines to be injected, i.e., it does not account for an estimated 3.165 million yd3 of newly washed fines. The estimated cost to inject this volume of material is about $18.2 million. Under Alternative 4, the chat processors would eventually be responsible for cleanup of the newly washed fine tailings since the OU4 remedy would have been completed many years prior to closure of the chat processing sites. This has the potential to shut down chat sales completely which would result in a future remedy for the huge volume of unprocessed chat at a much greater than current remedial options. Current remedies depend on chat sales to deal with reduction in volume of chat. Under Alternative 5, this material would be dealt with by the remedy under its longer time frame.

Response: If injection of fines is found to be infeasible or not comply with the ARARs, then chat processors will be expected to continue following the Best Management Practices for the handling of fines. Where new fines are being added on top of existing tailings ponds, the increase in the cost of the remedy is negligible since the overall footprint of the tailings pond would not be expected to change. In this situation, EPA would wait until chat washing was concluded prior to implementing a cover system at that location.

Comment 72: Table C-2 Phase 2 Activities Item 14 p 5/8, if you assume that 76% of all the chat is processed and 9,380,000 yd3 which implies that there will be 39,083,333 yd3 of chat with an addition 7,035,000 yd3 for a sum total of 46,118,333 yd3 which is more volume than the amount of chat for use that is available. Please clarify.

Response: Modifications are reflected in the ROD.

Comment 73: Primary aspects of the current Plan DEQ are not in agreement on: 1) cost appears to be the sole factor in the Preferred Alternative Selection 2) Cost evaluation for Alternative 4 and 5 is vague and appears misrepresented 3) permanent relocation is not in the Preferred Alternative 4) chat sales are not a component of the remedy 5) potential adverse surface water impacts are not addressed

Response: With respect to items 1 and 2, EPA implemented a detailed analysis process in accordance with the nine criteria prescribed by the National Contingency Plan (NCP) (40 CFR Part 300), which includes consideration of cost. Under the NCP, cost can only be considered in selecting a remedy from among protective alternatives. The remedy selection process requires that alternatives must be demonstrated to be protective and ARAR-compliant (or justify a waiver) in order to be eligible for

consideration in the balancing process by which the remedy is selected. This sequence of steps ensures that the selected remedy will be protective of human health and the environment. Cost is a relevant factor for consideration as part of the selection of the remedy from among protective, ARAR-compliant alternatives. In many instances, since certain components of select remedies were reasonably similar, detailed analysis was limited to those criteria which were significantly different. Cost was one of the few criteria where the difference between alternatives was significant, and therefore merited substantial comparison between alternatives. With respect to item 3, EPA has reconsidered the inclusion of a voluntary buyout as part of the remedy. This decision is reflected in the ROD. Chat sales are part of the remedy for OU4. Requirements to ensure environmentally acceptable chat use are part of the remedy. Removal of source materials from in-stream locations and ultimately from the watershed will prevent or limit discharges of chemicals of concern (COC) from source materials into surface water. However, surface water remediation is generally not part of OU4.

Comment 74: Cost Evaluation - Several fundamental changes to the assumptions that have an impact on the cost -- it assumes that the same amount of material remains after the end of Phase I for both Alternatives 4 and 5 and it decreases the time frame for Alt. 5 from 35 years to 30 years. DEQ believe that this assumption is flawed. The additional time should result in more chat being sold, leaving less to manage under Phase II and decreasing the cost. It is not clear why EPA changed this but it appears to be a way to make Alternative 5 less attractive from a cost perspective. We calculated the net present value of Alternative 5 using the 35 year timeframe. The result was a cost difference of $20,948,583 between Alternative 4 and Alternative 5. It is worth noting here that the administrative cost of URA is estimated at $17,358,447.

Response: EPA included relocation in its selected remedy for OU4 and has extended the timeframe for chat sales to 30 years. With the passage of WRDA, certain cost savings can be realized, and this makes the selected remedy, including relocation, more cost effective. For a detailed discussion on the cost savings please refer to the OU4 ROD at Section 20.3 (Cost-Effectiveness).

Comment 75: If Alternative 4 does not remove chat at the rate assumed in the 20 years, the cost of that alternative will be much higher. The 1.9 million tons per year estimate is higher than the current rate of 0.9 million tons land is based on an expanding market. Recent trends appear to show a slowdown due to high fuel costs and an associated slowdown in asphalt road construction. There is no direct way to increase the chat usage rate since sales are not part of the remedy.

Response: EPA's preferred alternative was modified to extend chat sales an additional 10 years (from 20 to 30 years). This modification will enable more chat to be removed from the site, thus reducing the volume of chat that may need to be addressed in the remedial action. The remedial cost estimates were prepared using current year (2007) pricing data and forecast over a 30-year construction and operation and maintenance period to determine net present value. A discount rate of 7 percent was used in the net present value analysis of alternatives, the discount is calculated before taxes and after inflation. The cost criterion analysis for this evaluation was performed in accordance with EPA guidance and cost estimates are expected to be accurate within a range of -30 to +50 percent.

Based on State, Tribal and community concerns, and the passage of relocation language contained in the Water Resources Development Act of 2007 (WRDA), EPA reevaluated relocation and the selected remedy for OU4 was also modified to include relocation. Thus, any remaining target properties not addressed under the State buyout program will be addressed under EPA's selected remedy. As provided by WRDA, the voluntary relocation will not follow the Uniform Relocation Act regulations, but will continue to follow the procedures and priorities established by LICRAT and will be implemented by LICRAT.

With the passage of WRDA, certain cost savings can be realized, and this makes the selected remedy, including relocation, more cost effective. For a detailed discussion on the cost savings please refer to the OU4 ROD at Section 20.3 (Cost-Effectiveness).

Comment 76: The cost evaluation also fails to consider how relocation would enhance production by the use of larger equipment, fewer restrictions on roads, etc. The cost difference could be significant.

Response: With the passage of relocation language contained in the Water Resources Development Act of 2007, EPA reevaluated relocation and the selected remedy for OU4 was modified to include relocation. Certain cost savings were identified, enabling the selected remedy to be cost effective. For additional information on the cost savings, please see the OU4 ROD at Section 20.3 (Cost-Effectiveness).

Comment 77: Reiteration of DEQ April 16, 2007 comments that were unsatisfactorily addressed - some new language is added. Permanent buyout must be included in the Preferred Alternative. The environment in which the OU4 remedy will be implemented is of a singular character. The chat piles, mill ponds and other contaminant sources are located in, around, and among the residential areas of Picher, Cardin, and Hockerville, The movement of contaminant sources and the use of heavy construction equipment in so populated an area will pose an unacceptable risk to the residents.

Response: Based on comments like this from the State, comments from the Quapaw Tribe, comments from the affected community, and based on the favorable provisions of the WRDA of 2007, EPA reevaluated relocation which it had rejected in the Proposed Plan. Based on our findings, the selected remedy for OU4 was modified to include relocation. Additional information on this modification is in ROD Section 4.0 (Description of the Selected Remedy).

Comment 78: The construction aspects of the remedial alternatives are likely to require imposition of certain significant use restrictions that members of the community will consider unacceptable. These restrictions include street barricades for extended durations, temporary disconnection of utilities, use of earthmoving equipment in residential areas, and if necessary, prolonged temporary relocations of residents. Other impacts would be noise, vibrations and traffic congestion. Land use restrictions in the form of institutional controls on source material repositories will also impose serious restrictions on residents that many may find unreasonable. Relocation would avoid the impact and inconvenience associated with these restrictions. Such relocation would, of necessity, be long-term and could well last for more than a decade. Temporary relocation for so prolonged a period of time would place an unacceptable burden on the community. Perhaps, most importantly, human exposure to chemicals of concern in fugitive dust and source materials deposited on streets and roadways during urban remedial operations on source materials poses risks to site residents.

Response: All of the restrictions noted in the above comment were evaluated by EPA in the December 2007 Feasibility Study, that is part of the OU4 Administrative Record. Based on public comments, the comments of the Quapaw Tribe, the comments of the State, and facilitated by the passage of the Water Resources Development Act of 2007 (WRDA), EPA reevaluated the preferred alternative that it released to the public in the Proposed Plan. Instead of the preferred alternative—Proposed Plan Alternative 4, EPA selected a modified Alternative 5 which includes relocation and an extended timeframe for chat sales.

Comment 79: The impacts to the communities both from existing conditions and the implementation of the remedy warrant the relocation of residents. The discussion in Section 5 should reflect this.

Response: Based on public comments, the comments of the Quapaw Tribe, the comments of the State, and facilitated by the passage of the Water Resources Development Act of 2007 (WRDA), EPA reevaluated the preferred alternative that it released to the public in the Proposed Plan. Instead of the preferred alternative—Proposed Plan Alternative 4, EPA selected a modified Alternative 5 which includes relocation and an extended timeframe for chat sales.

Comment 80: The revised Preferred Alternative does not discuss flood management in a meaningful way. It is discussed in the Feasibility Study but is not in the Proposed Plan. EPA had agreed to incorporate this but failed to do so. We have discussed at length that the design of individual sites will require water balance calculations and the design of features to mitigate flooding. The State believes that the removal of chat piles, which have tremendous storage capacity, will significantly alter storm water runoff and removal of these features from the surface will increase the potential for flooding. A regional flood management

plan needs to be included in the Preferred Alternative to consider and plan for the regional impact of the remediation

Response: EPA acknowledges this concern and has plans for addressing this during the Remedial Design. That is, EPA sees this issue as an implementation issue to be addressed during RD, rather than as a remedy selection issue. Nonetheless, this concern has been acknowledged and addressed in this ROD. In addition, the hydrologic study will begin to look at issues such as the storage capacity of chat piles and how the piles recharge and discharge over seasonal weather variations. This information will be useful in addressing this concern. In addition, as stated in the FS Report, best management practices for the control of storm water runoff during construction and engineering controls will be implemented as necessary to abate the potential for increased runoff.

Comment 81: The preferred Alternative is silent on how the rural residences that participate in the buyout will be addressed. We recommend that you indicate that these will be managed similar to the transition zone soils. We also recommend that you add similar direction on managing the soils in the footprints of homes removed by the buyout. EPA's response was to have the USACE funding that covers demolition of properties cover this. However, our understanding is that the USACE authority is limited to demolition, NEPA and relocation of road and utilities and does not cover soil cleanup. The USACE funding is not adequate to address this. Soil remediation for soils above the action level is consistent with EPA authority under CERCLA for this site.

Response: EPA does not plan to remediate any residential properties that are involved in the State's relocation effort, since the land use of these properties will change. A change is expected for residential and commercial settings in Picher, Cardin and Hockerville which are included in the voluntary relocation. Future land use of the properties that are purchased as part of the State's voluntary buyout being conducted by the LICRA Trust is not stipulated in their authorizing legislation (Oklahoma Senate Bill 1463); however, the Trust will hold the title to the properties acquired through the buyout.

Though EPA will not take an interest in any real estate as part of the relocation elements of the OU4 ROD, EPA will provide funds to the LICRAT to use for relocation of residents in targeted areas. The State has agreed that the ODEQ will file a "Notice of Remediation or Related Action Taken Pursuant CERCLA, and the Creation of an Easement" on each property acquired by LICRAT, pursuant to the State's authority under Oklahoma Statutes 27A § 2-7-123(B), and that this easement will restrict access to the property to uses that EPA agrees are compatible with the remedy selected in the OU4 ROD.

The Quapaw Tribe adopted a zoning ordinance in 2007 that established planned uses of Quapaw lands. The goal of the zoning ordinance is to preserve all future uses of the land including residential, agricultural, conservation, forestry, industrial and commercial.

Structures that remain after residents have been relocated will be removed or demolished and disposed by the LICRA Trust.

Comment 82: The cost for cleanup of rural residences appears low based on EPA's past costs. The estimated average cost should be closer to $50,000 per yard, which is relatively close to the average cost of buying out residences altogether under the ongoing buyout assistance program.

Response: The remedial cost estimates were prepared using current year (2007) pricing data and forecast over a 30-year construction and operation and maintenance period to determine net present value. A discount rate of 7 percent was used in the net present value analysis of alternatives and also used before taxes and after inflation. The cost criterion for this evaluation was performed in accordance with EPA guidance and cost estimates are expected to be accurate within a range of -30 to +50 percent.

Based on State, Tribal and community concerns, and the passage of relocation language contained in the Water Resources Development Act of 2007, EPA reevaluated relocation and the selected remedy for OU4 was modified to include relocation. Thus, any remaining properties not addressed under the State buyout program will be addressed under EPA's selected remedy. As provided by WRDA, the voluntary relocation

will not follow the Uniform Relocation Act regulations, but will continue to follow the procedures and priorities established by LICRAT and will be implemented by the Trust, as part of the State of Oklahoma's voluntary buyout. As a result of this modification, relocation as provided in the selected remedy will be cost effective.

Comment 83: The assumptions on the volume of chat sales in EPA's preferred alternative seem unreasonably optimistic. Chat sales are reportedly going down. There is no contingency for these sales volumes assumptions not being achieved.

Response: EPA assessed information from chat processors and others in determining that approximately 95% of the chat will be removed from the site over a 30 year period through commercial sales. Allowing chat sales to continue for the extended period of time contributes to a more cost effective remedy since less chat will remain on-site that would need to be addressed. Nonetheless, as part of the five-year reviews that EPA will perform at the site, EPA will evaluate the progress of chat sales. Chat piles and bases remaining after 10 years will be evaluated for commercial viability. This determination will be made using input from the chat/land owners, appropriate Tribal representatives, and the commercial operators. Also, chat sales are an integral part of the remedy and EPA will facilitate activities to support the sale of chat. Additional information on the types of activities EPA will facilitate is presented throughout this OU4 ROD.

Comment 84: The inclusion of chat sales as a component of the proposed remedy is an implicit recognition that there is significant residual value in the chat remaining at the Site.

Response: EPA agrees with the commenter that much of the Site chat has commercial value. The marketable chat, however, is all privately owned, so any revenue generated from its sale would accrue to those owners. Nonetheless, the sale of the chat and its use in an environmentally acceptable manner as called for in the ROD, will address a large part of the source material on the Site, and keep remedy costs down. There is also much chat that is unmarketable because it is intermingled with unsuitable material, or because it is located in such an inaccessible area or in such a small pile that it would cost too much to retrieve—making it unprofitable to market. This unmarketable chat will be addressed as provided in the ROD.

23.3 Community Outreach History

Throughout the history of the Tar Creek Superfund Site (the "Site"), the U.S. Environmental Protection Agency (EPA) in coordination with the Oklahoma Department of Environmental Quality (ODEQ), and the Quapaw Tribe has kept the community, public, governmental entities, citizen advisory groups and interested parties informed of Superfund response actions, and involved these groups in planning.

The EPA used various methods for informing communities on site activities at Superfund sites, and for seeking public participation in the National Contingency Plan (NCP) process. One routine activity EPA uses for updating a community is the development of site Fact Sheets, and newspaper notices. Informational Fact Sheets at Superfund sites are routinely mailed to individuals on the site mailing list, which includes community members located within approximately one mile of the site, elected officials, and other interested parties who have requested information or who have attended public meetings

At the Site, EPA met with community members and performed various outreach activities in response to the Site-specific needs of the community. This included responding to citizens, neighborhood associations, and other community organizations through informal discussions, community open houses, and public meetings. The site mailing list is included in Index.

Under the statutory requirements of Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and its implementing regulation 40 CFR § 300.430(f)(4)(ii), every five years, EPA is required to review sites it has addressed under Superfund where hazardous substances remain on-site above concentration levels that allow for unrestricted use and unrestricted exposure. Three five-year reviews have been performed at the Tar Creek

Site. The first was completed in April 1994, the second five-year review was completed in April 2000 and the third review was completed in September 2005. The most recent Five-Year Review Report is available online at http://www.epa.gov/earth1r6/6sf/pdffiles/tc_5yr_2005-09.pdf. EPA interviewed local citizens as part of each one of these Five-Year Reviews.

Listed below is a detailed summary and chronology of the various public outreach efforts:

- A Memorandum of Understanding was signed in May 2003 between the EPA, the DOI, and the U.S. Army Corps of Engineers. The purpose of this Memorandum is to facilitate a coordinated response to environmental contamination, physical safety concerns (open mine shafts, subsidence, and flooding), and poor economic conditions at the Tar Creek area. Other participants include the U.S. Fish & Wildlife Service, the U.S. Geologic Survey, the U.S. Bureau of Indian Affairs, and the Tribes.

- On December 9, 2003, the EPA signed an Administrative Order on Consent (AOC) with three Potentially Responsible Parties (PRPs), including DOI, Blue Tee Corp., and Gold Fields Mining Corporation, to conduct the Remedial Investigation/Feasibility Study (Remedial Investigation/Feasibility Study) for OU4. Under the terms of the AOC, the EPA prepared the risk assessments for OU4 based on data collected by the PRPs and EPA.

- March 29 to April 28, 2005, a three-phased Site Reconnaissance was conducted. During the Site Reconnaissance, field characterization of the mine and source materials was conducted and sampling sites for the Remedial Investigation were selected with concurrence of EPA, the ODEQ, the Quapaw Tribe and other participating organizations. Field sampling and investigations were conducted in May and concluded in October 2005.

- November 2005 - Meeting with stakeholders, conducted to discuss draft documents (draft Ecological and Human Health Risk Assessments, the modified Remedial Action Objectives--including the draft Preliminary Remediation Goals) and to provide additional insight to our partners regarding EPA's planned schedule for preparing a Record of Decision for Operable Unit 4 (OU4). A facilitator and court reporter were utilized.

- December 2005 - The potentially responsible parties (PRPs), Blue Tee Corp, and Gold Fields Mining, L.L.C. funded in part by the U.S. Department of the Interior submitted a draft Feasibility Study (FS) to EPA. The draft FS was posted on a secured website for EPA's partners to review. EPA's partners that reviewed and commented on the FS included: The Oklahoma Department Environmental Quality (ODEQ), Quapaw Tribe and other local Tribes.

- January 2006 - EPA presented its draft Preferred Alternative to the EPA's Remedy Review Board. Representatives from ODEQ and the Quapaw Tribe, were present and presented their concerns.

- The U.S. Army Corps of Engineers (USACE) released a report concerning the threat of subsidence in Ottawa County. This report caused EPA to reevaluate its plans for remediation of the Site.

- February 2006 - EPA notify the PRPs it will revise the FS, due to new information presented in the USACE subsidence report, and due to impacts that the potential State relocation of Site residents could have on remedial alternatives that had been evaluated in the FS.

- March 2006 – Draft Proposed Plan modified to reflect subsidence considerations (internal review).

- May 2006 – MOU Principals Meeting - The meeting was held at EPA Region 6 office, 1445 Ross Avenue, Dallas, Texas. Discussions included the impacts of the Subsidence Report on Tar Creek activities, next steps and to confirm schedules for all site projects. The goal was to maintain coordination and enhance possibilities for a holistic approach at Tar Creek. As provided in the MOU, EPA meets with stakeholders. Attendees were: Gen Dorko, USACE, Bob Laidlaw/DOI, Miles Tolbert, Office of the Secretary, and John Berrey/Quapaw Tribe

• December 2006 – Draft Proposed Plan and draft FS are made available to ODEQ, the Quapaw Tribe and the 10 Downstream Tribes for review/input (40 CFR §300.515(h)(3)).

• January – March 2007 – Numerous meetings, consultations and conference calls are conducted with all affected Tribes, the state, and DOI, to discuss the December 2006 draft Proposed Plan and concerns (40 CFR §300.515(h)(3)). Both the State and the Quapaw Tribe express concerns regarding the land use. Specifically, the Tribe and the ODEQ essentially said that the proposed remedial alternatives capped too much contaminated material in place. They essentially said that this capped area would leave too great a footprint on the land, impeding future use. Concerns identified by ODEQ and the Tribe included:

- Land use concerns/footprint, tribal lifestyle,
- Operations and Maintenance associated with the preferred alternative,
- The use of too much soil for capping.

• January 22, 2007 – Tribal Consultation – Coordination Meeting. Executive Order 13275 was signed November 6, 2000, and established several provisions regarding consultation and coordination between Federal agencies undertaking actions that have tribal implications. Tribal Consultation meeting were held to seek meaningful and timely communications and to seek, discuss and consider tribal views and tribal interests. A meeting for tribal consultation was held on January 22, 2007 at the Tribal Complex facility in Miami, Oklahoma. In attendance were: Nancy John/Cherokee Nation, Roxanne Weldon/Eastern Shawnee Tribe of Oklahoma, Mike Rutledge/Miami Tribe of Oklahoma, John Ballard/Modoc Tribe of Oklahoma, Rosanna Sheppard/Ottawa Tribe of Oklahoma, Jim Dixon Peoria Tribe of Indians of Oklahoma, Tim Kent/Quapaw Tribe of Oklahoma, Paul J. Barton/Seneca-Cayuga Tribe of Oklahoma and Jodi Hayes/Shawnee Tribe Brandi Ross/United Keetowah Band of Cherokee Indians of Oklahoma and Christen Creson/Wyandotte Nation. Upon completion of the consultation and before the proposed plan was released to the public, EPA Region 6 Superfund Division Director meet again with the Tribes to explain the Agency's final decisions for the proposed plan. The Agency complied with the requirements of the Executive Order while transmitting the draft proposal.

• January 23 thru January 24, 2007 – Meeting with State and Quapaw Tribe in EPA's office – discussion ODEQ and Quapaw Tribe's modified alternative, provide clarification and answer questions regarding costs, assumptions made etc.,

• January 31, 2007 – Tribal Consultation – Technical Meeting - In attendance were: Nancy John/Cherokee Nation, Roxanne Weldon/Eastern Shawnee Tribe of Oklahoma, Mike Rutledge/Miami Tribe of Oklahoma, John Ballard/Modoc Tribe of Oklahoma, Rosanna Sheppard/Ottawa Tribe of Oklahoma, Jim Dixon Peoria Tribe of Indians of Oklahoma, Time Kent/Quapaw Tribe of Oklahoma, Paul J. Barton/Seneca-Cayuga Tribe of Oklahoma and Jodi Hayes/Shawnee Tribe Brandi Ross/United Keetowah Band of Cherokee Indians of Oklahoma and Christen Creson/Wyandotte Nation

• February 21, 2007 – Inter Tribal Environmental Counsel (ITEC) meeting – EPA's Region 6 Division Director expressed EPA's desires to receive the Tribes input on the Consultation Process and provide a status of his efforts.

• February 28, 2007 – Regional Tribal Operations Committee (RTOC) meeting

• March 1, 2007 – Weekly conference call with ODEQ and Quapaw Tribe to discuss progress of their development of a modified alternatives and clarification on assumptions

• March 2, 2007 – E-mail sent to all Tribal Environmental Directors listed above providing clarification on the 1/22 consultation meeting requesting their input on the Consultation Process and the envisioned date to have a public meeting.

• March 9, 2007 – EPA met with Quapaw Tribe to discuss cost tables for OU4

• March 14, 2007 EPA met with representatives of the Quapaw Tribe and ODEQ to discuss their modified suggested alternative for OU4.

• March – July 2007 - Proposed Plan modified, where possible, based on input from Quapaw Tribe, ODEQ and other affected Indian Tribes in the Tar Creek area. Input included concerns of water quality, health issues, chat in mine works, chat in mine workings, drainage around mine works and chat piles. FS is also modified.

Fact Sheet/Newsletters

All Fact Sheets and Newsletters were mailed to all listings on the Tar Creek Superfund Site mailing list, which include EPA state and federal partners, Oklahoma local government and all eleven Indian Tribes in the Tar Creek area.

June 2007/Tri-State Mining District - Chat Mining Waste
April 2007/Maintenance of Soil
April 2007/Residential Soil Sampling
March 2004/Update – Overview/Update of site activities
January 2004/Chat Piles & Mill Ponds – Fact Sheet informing public of the Administrative Order on Consent for Operable Unit 4 (chat piles) to conduct the Remedial Investigation /Feasibility Study (RI/FS).
November 2004 – Fact Sheet – Information Yard Remediation
August 2003/Tar Creek Site News – Continued cleanup activities
May 2003/TarCreek News – Information on the removal of contaminated soil from properties in North Miami
May 2003/Environmental News – EPA announced its signing of a Memorandum of Understanding (MOU) with the U.S. Dept. of the Interior and the U.S. Dept. of the Army to develop and implement solutions to the human health and environmental threats posed by the Tar Creek Superfund site locate din northeastern Oklahoma and other states.

Public Notices
All notices were published in the Miami News Record

November 2005/Five-Year Review of Site Remedy
July 2004/Notice of Five-Year Review of site Remedy

Community/Stakeholders meetings
Meetings were held at various locations including the Miami Civic Center, Tribal Complex and Picher Cardin High School

January 2007/Tribal Consultation – Coordination Mtg.
February 2007/RTOC Meeting
February 2007/ITEC Meeting
March 2007/Quapaw Tribe & ODEQ
November 2005/Stakeholders Meeting
March 2005/Watershed – Update activities for the site and discussion of Memorandum of Understanding
March 2004/Open House – Overview of site activities, Exhibits, One-on-One discussions
March 2004/Community Meeting
June 2004/Property Owners Meeting

24.0 TECHNICAL AND LEGAL ISSUES

24.1 Technical Issues

In the Proposed Plan for OU4, EPA proposed injecting chat and fine tailings into the underground mines as a permanent disposal method. The proposed inclusion of this technology into the overall remedial strategy for OU4 was based on positive results from pilot studies conducted at the Site. EPA received several

comments from the affected community with concerns about the full-scale application of injection. These commenters were concerned about the long-term impacts on the ground water and surface water at the Site and downstream of the Site. In the Proposed Plan, EPA proposed including the implementation of a hydrogeologic study into the remedial strategy to address these community concerns. Our proposal essentially said injection would only be undertaken as part of the Remedial Action if the results of the hydrogeologic study were favorable. This approach is consistent with the Underground Injection Control (UIC) regulations that are identified as an ARAR for the selected remedy. The UIC regulations define the type of mine backfill well described in this ROD as a Class V injection well. Therefore, as part of the remedial action, it must be demonstrated that injection activity does allow the movement of fluid containing any contaminant into underground sources of drinking water supplies, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR Part 141, other health based standards, or may otherwise adversely affect the health of persons. The hydrogeologic study will be used to address this criterion. If the study does not demonstrate that the injection can meet the UIC regulations then EPA will not proceed with full-scale implementation and will use capping as the sole technology for the fine tailings and disposal in a repository or release to a chat processor for other source material.

The implementation of the hydrogeologic study is currently underway. EPA has met with the State and Tribes to discuss the scope of the work. A work plan that will guide the work will be forwarded to the Tribes and the State for review in the first quarter of 2008. The implementation of the work is expected to take 3 years.

EPA conducted several pilot studies to evaluate the feasibility of injecting chat and fine tailings fines into the flooded mine workings at the Site. Pilot studies were conducted at the locations of the Montreal and Craig mines using pile-run chat (*i.e.,* unwashed chat containing both the gravel-like material and the fine tailings). Pilot studies were also conducted at the Tulsa mine, using the fine tailings from a chat washing operation. The details of the pilots are contained in the Interim Data Report for the Chat Placement Pilot Study (February 2006) and the Chat and Chat Fines Placement Pilot Studies Report (July 2006).

24.2 Legal Issues

Paperwork Reduction Act

The information collection requirements in this ROD are the essentially the same as those required under EPA's Criteria for the Safe and Environmentally Protective Use of Granular Mine Tailings Known as ``Chat'' (the "Chat Rule"), 40 CFR Part 278. The difference is that, under this ROD, EPA is marginally expanding the information collection requirements of the Chat Rule so that they apply to all uses of chat from the Site, not just to chat used in federal transportation projects. Our best professional judgement is 90% of all chat that is taken from the Site is currently used in federal transportation projects. Since chat users that provide chat for federal transportation projects must already meet the paperwork requirements of the Chat Rule, the paperwork requirements established under this ROD will only expand application of the paperwork requirements by less than 10%. Moreover, this ROD's expansion of the information collection provisions will probably not affect any more parties than are already affected by the paperwork requirements of the Chat Rule. The reason that no additional parties will be affected is that there are a very limited number of operators, and agencies involved. *See* "Assessment of Costs, Benefits, and Other Impacts of Chat Use in Transportation Projects" (January 2006) at pp. 18-19.

The Chat Rule information collection requirements have been submitted for approval to OMB under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. via the preamble to the Chat Rule (72 Fed. Reg. 39331-39353) instead of a separate Information Collection Request (ICR) document, since the burden associated with this rule is insignificant. Since information collection requirements established in this ROD only marginally expand the Chat Rule requirements, and since they probably do not affect any more parties, EPA is relying on the Preamble discussion of the information collection requirements made in the Chat Rule to satisfy the OMB Paperwork Reduction Act approval requirements for this ROD.

The certification, reporting, and record keeping required under the Chat Rule and this ROD are necessary to ensure the safe use of the product containing chat. Certification, recordkeeping and reporting requirements under this ROD are not subject to confidentiality restrictions. Since additional paperwork burden associated with this ROD is insignificant, a separate ICR is not necessary. The burden is projected to affect a limited number of entities. These include: three State governments (Oklahoma, Missouri, Kansas), one Native American Tribe (Quapaw Tribe of Oklahoma), and no more than fifty sand and gravel companies located in the States of Oklahoma, Missouri, and Kansas (NAICS 4233202). It is estimated that there will be an insignificant additional burden associated with the paperwork requirements under this ROD. In fact, due to the conservative nature of the burden projections made in the preamble to the Chat Rule, it is estimated that the total burden on affected entities (*i.e.,* the combined burden of the paperwork requirements of this ROD and the Chat Rule) will remain within the total estimated burden projected for the Chat Rule alone, as described in the preamble to the Chat Rule (72 Fed. Reg. 39331-39353).

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GLOSSARY OF TERMS

Administrative Record File - Contains those documents that form the basis for the selection of a response action.

Antimonial Lead - Consists of a lead alloy containing about 5 percent antimony.

Applicable or Relevant and Appropriate Requirements (ARARs) - Cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

Aquifer - A layer of permeable rock, sand, or gravel below the ground's surface that can supply usable quantities of ground water to wells and springs. An aquifer can be a source of drinking water.

Best Management Practices (BMPs) - Best Management Practices are broadly defined by EPA under Section 304 of the Clean Water Act (including its implementing regulations at 40 CFR § 122.44(k)) as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of water of the U.S. Best Management Practices also include treatment requirements, operating procedures, and practices to control industrial site runoff, spillage or leaks, or drainage from raw material storage piles, erosion controls, dust suppression methods, or air monitoring as needed as determined by EPA for verification purpose. In general, BMPs components include:

- Controlling process water to avoid discharge to surface water during and up to a 25-year storm event.
- Constructing berms around mill ponds or surface impoundments capable of retaining water without seepage.
- Developing contingency measures and response plans to address releases from source water, process water, sediment and storm water.
- Controlling storm water runoff within the process areas, controlling soil erosion on-site, and controlling drainage.
- Containment of stockpiles of chat to prevent spread of contaminated material.
- Dust mitigation to minimize dust generated from the processing of chat and on-site haul roads to include wetting, mist curtains, and foam blankets.
- Air monitoring during chat processing, as needed as determined by EPA, to confirm air quality and effectiveness of dust mitigation.
- Controlling releases from trucks hauling raw and/or processed chat off-site to prevent fugitive dust and off-site tracking of contaminated soil to include covering truck loads of chat with tarps and washing trucks prior to leaving the site and entering public roads to prevent tracking.
- Decontamination of personnel and equipment
- Access controls like fences and gates

Chat - waste materials that was formed in the course of milling operations employed to recover lead and zinc from metal bearing ore minerals.

Chat Base - The area that was once occupied by a chat pile.

Chert - A very hard and resistant rock that occurs as nodules within the dolomites and limestones of the Ozarks.

Clinker - A waste from coal combustion. It is usually gray to dark gray in color. The size of the clinker fragments seen at the former Ottawa smelter location varies from about one inch in diameter (pebbles) to less than one tenth of an inch in diameter (fine sands). Clinker has a honeycomb (pumiceous) texture and thus is much less dense than slag or native rock material.

Consolidated Deposit - A consolidated deposit is defined as an agglomeration of materials that are temporarily placed or consolidated prior to being put to some beneficial use or in preparation for transport or final disposal.

Development rock - the waste rock generated in drilling shafts to the deep mines.

Distal Areas – Areas that are generally located outside the high density mining areas and include rural areas as shown in Figure 3.

Ecological Risk Assessment - A process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical, physical, or biological stressors.

Fine Tailings - Sand-like tailings from mining, milling processes including chat washing and flotation processes. Generally these fine tailings are found in tailings ponds.

Feasibility Study - A study undertaken by the lead agency to develop and evaluate options for remedial action. The Feasibility Study emphasizes data analysis and is generally performed concurrently and in an interactive fashion with the remedial investigation, using data gathered during the RI.

Floodplain - Areas inundated by a flood with a return interval of 100 years

Flux - A variety of materials used to purify metals or prevent undue oxidation of molten metal surfaces.

Gangue materials – Impurities including sand and rock that surrounds the mineral of interest in an ore.

Ground Water - Water found beneath the ground surface that fills pores between soil, sand, and gravel particles to the point of saturation. When it occurs in a sufficient quantity, ground water can be used as a water supply.

Hazard Quotient or Index - Non-cancer "risks" are described as a number called the hazard quotient (or hazard index for multiple chemicals), which is a ratio of the actual chemical dose to the Reference Dose. For ecological risk assessment, this ratio is exposure concentration or dose divided by the ecological toxicity values. A hazard quotient of one or less is considered protective.

Human Health Risk Assessment - At Superfund sites, human health risk is the chance that chemicals from a site will cause health problems. A risk assessment answers four basic questions: is there a risk, who is at risk, how great is the risk, and what is causing the risk.

In-Stream Source Material - Source material accumulations located within the streambed of flowing streams including intermittently (*e.g.,* seasonal) flowing streams.

Institutional Controls (IC) - Administrative and/or legal mechanisms that: (1) help minimize the potential for human exposure to contamination, and (2) protect the integrity of the remedy. ICs accomplish these objectives by directly limiting land or resource use, and/or by providing information that modifies behavior.

Maximum Contaminant Level (MCL) - Maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Microgram per Deciliter (µg/dL) - Units of measure used to express the concentrations of lead in blood. As an example, one µg/dL of lead would be equivalent to one drop in 18,800 gallons.

National Priority List (NPL) - The NPL means the list, compiled by EPA pursuant to CERCLA section 105, of uncontrolled hazardous substance releases in the United States that are priorities for long-term remedial evaluation and response.

Native Soils - soil that was present prior to the start of mining operations at the Site and is generally free from Source Materials. The most common native soil series that is present within the Site is the Taloka silt loam, however, other soil series may exist.

Near-Stream Source Material - Source material accumulations located within the active floodways of perennial streams and major tributaries. Near-stream source materials consists of deposits that are subject to stream erosion during flooding events and may also include sources of out-washing chat or chat seepage that are capable of being transported to and deposited in perennial streams and major tributaries by surface water. These source materials may act as significant surface water loading sources. This category does not include bed or bank sediments that have already been deposited in streams.

Operable Unit - A discrete aspect of a Superfund Site defined by EPA. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site.

Operable Unit 4 (OU4) – Operable Unit 4 means the portion of the Tar Creek Superfund Site that occupies approximately 40 square miles in the northern portion of Ottawa County, Oklahoma, and is generally depicted in Figure 1. OU4 includes the parts of the Site (both urban and rural) that are not currently used for residential purposes or which are sparsely used for residential purposes, where mine and mill wastes and smelter waste have been deposited, stored, disposed of, placed, or otherwise come to be located. Areas where such material has come to be located will include without limitation chat covered haul roads and non-operating railroad grades. OU4 includes residential yards located in Ottawa County outside of city or town limits except for those residential yards that have been addressed under OU2. . OU4 includes areas where mine and mill wastes and smelter wastes have been moved by anthropogenic activities (*e.g.,* where chat has been used as a driveway or fill in a rural area) or by natural actions including erosion (*e.g.,* where chat has washed from a chat pile into a stream). OU4 generally does not include sediment, except where sediment is incidentally addressed when chat is removed from in-stream or near-stream areas. OU4 does not include ground water or surface water, except indirectly in that the remedial action for OU4 will eliminate some of the sources of ground water and surface water contamination. OU4 does not include contamination in streams that is due to mine drainage. OU4 includes all suitable areas in very close proximity to the contamination necessary for implementation of the response action. OU4 also includes Site areas selected for repositories for the disposal of source materials and contaminated soils and sediments. Notwithstanding the preceding provisions of this OU4 definition, OU4 also includes residences and businesses in areas targeted for relocation including residences in Picher, Cardin and Hockerville. The areas targeted for relocation are generally described on the Map that is attached as Figure 9.

Opportunistic Sampling – Collecting surface samples of identified smelter wastes that is scattered and in limited amounts at the site.

Organic Matter - Any type of natural composted or non-composted plant materials, animal manures, or sewage sludge that are used in applications that amend and stabilize soils, mulching, creating anaerobic treatment systems, and other remedial actions. Biosolids, poultry litter, spent mushroom compost, cow manure, hay, yard wastes, wood chips, saw dust, or other similar materials are all examples of organic matter that fall under this generic term.

Overburden - material overlying a useful mineral deposit that is removed to reach the mineral deposit.

Potentially Responsible Parties (PRP) - Any individual or company, including owners, operators, transporters or generators, potentially responsible for, or contributing to a spill or other contamination at a Superfund site.

Parts Per Million (ppm): mg/kg; mg/L - Units of measure used to express concentrations of contaminants. The concentration of contaminates in soil is expressed as mg/kg. The concentration of contaminates in water is expressed as mg/L. One pm is equal to one mg/kg or one mg/L. As an example, one ounce of benzene in one million ounces of water is 1 ppm of benzene.

Record of Decision (ROD) - A public document that explains which cleanup alternative(s) will be used at a Superfund site.

Remedial Investigation (RI) - An investigation that determines the nature and extent of contamination at the Site. The scope of an RI can vary widely from a small specific activity to a complex study. The next step following an RI is a Feasibility Study.

Rubble - A mass or stratum of fragments or rock, brick and concrete blocks, scrap metal and retort remnants.

Screening Level - A risk-based concentration used to compare preliminary investigation data for an initial evaluation of the environmental concern at a site. A chemical concentration larger than the screening value should be evaluated more carefully for potential risk.

Site – The Oklahoma portion of the Tri-State Mining District that consist of the areas of Ottawa County impacted by mining waste. The Site includes all of the area (approximately 40 square miles) in northern Ottawa County where lead and zinc mining operations were conducted and any area where a hazardous substance from mining or milling in Ottawa County has been stored or disposed. The Site also includes all suitable areas in very close proximity to the contamination necessary for implementation of the response action. The Site is bounded by the State of Kansas to the north. The principal Site communities include Cardin, Commerce, North Miami, Picher, and Quapaw.

Slag – A material composed of the oxides of gangue materials produced by gravity separation from molten metals during the smelting operations. It is dark gray to black in color. It is very dense compared to clinker or native rock material and usually has a molten appearance (amorphous).

Smelter-Affected Soils - Soils occuring within about 500 feet of the Site's only known smelter, the Ottawa Smelter located near Hockerville, Oklahoma.

Smelter Waste - Smelter-related waste materials and materials that were piled near the smelter, including slag (the oxides of gangue materials produced by gravity separation from molten metals), clinker (boiler residue), and flux (flux is a Si-Al-CaO composite, an additive used to separate iron from sulfides).

Soil Amendment - A generic term similar to organic matter that refers to a wide variety of organic and non-organic materials used for fertilizing, stabilizing, or improving the physical or chemical composition of soils. Soil amendments are typically used to create favorable conditions for plant growth or revegetating disturbed sites.

Soil Cover – This term defines a soil cap consisting of topsoil and subsoil layers designed to sustain a permanent vegetative cover under local climatic and physiographic conditions. The soil covers described in the Feasibility Study Report assume 12 inches of agronomic soils plus 12 inches of clayey soils for cost estimating purposes with placement to prevent erosion, promote evapotranspiration, and reduce, but not eliminate infiltration. The actual thickness of the soil cover will be determined in an engineering design, but would include a minimum of 12 inches total thickness.

Source Material – Smelter waste, and mine and mill waste including chat, fines, overburden, development rock, and other tailings. Source materials are generally found in chat piles, chat bases, and tailings ponds.

Tailings - Refuse or dross remaining after ore has been processed.

Tailing ponds – Areas that were once used for the disposal of water containing mine and mill waste, generally fines from the flotation process or fines from chat washing. Many of these tailings ponds are now dry or partially dry, and the mine and mill waste is left behind. Tailings ponds are also referred to as wash ponds, flotation ponds, slime ponds, and mill ponds.

To Be Considered - Consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

Transition zone soil - the soil found around and under the chat piles, chat bases, or tailings ponds extending outward from the piles or ponds.

Uniform Relocation Act - The Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs. 42 U.S.C Section 61, is the law that governs relocation of displaced persons when the Federal government is involved.

Appendix A
ODEQ Concurrence Letter

STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

BRAD HENRY
Governor

February 19, 2008

Sam Coleman (6SF-D), P.E., Director
Superfund Division
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Dear Mr. Coleman:

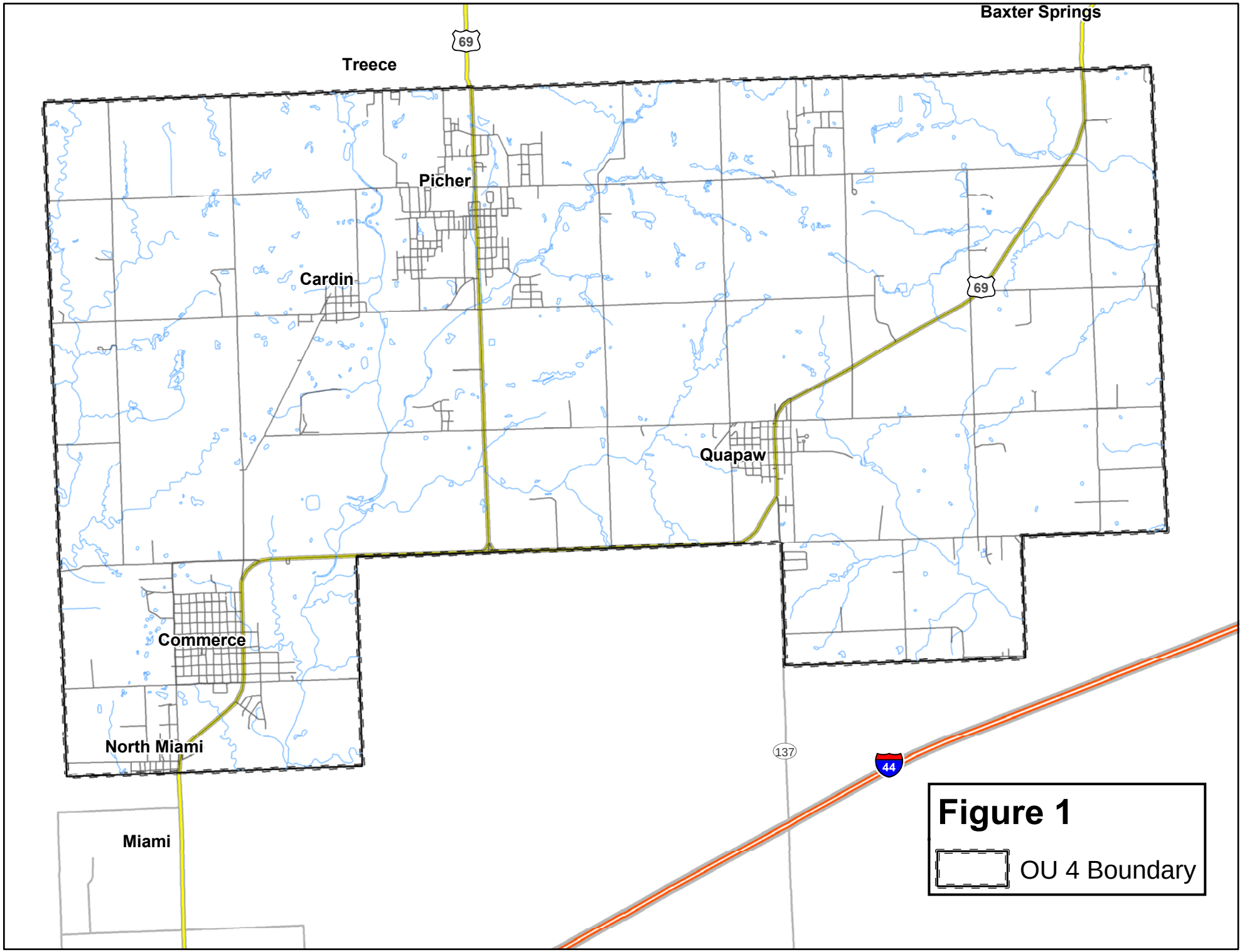
The Oklahoma Department of Environmental Quality (DEQ) concurs with and supports the Record of Decision for the Tar Creek Superfund Site Operable Unit 4. Our concurrence is based upon the most recent version of the Draft Record of Decision which you provided to us on February 15, 2008. The DEQ believes that the proposed remedy for Operable Unit 4 of the Tar Creek Superfund Site will provide long-term protection for public health and the environment.

The DEQ looks forward to our continued cooperative effort with the Region VI Office of the U.S. Environmental Protection Agency and the Quapaw Tribe as we proceed through Remedial Design and Remedial Action.

Sincerely,

Steven A. Thompson
Executive Director

Appendix B
Administrative Record Index


Baxter Springs
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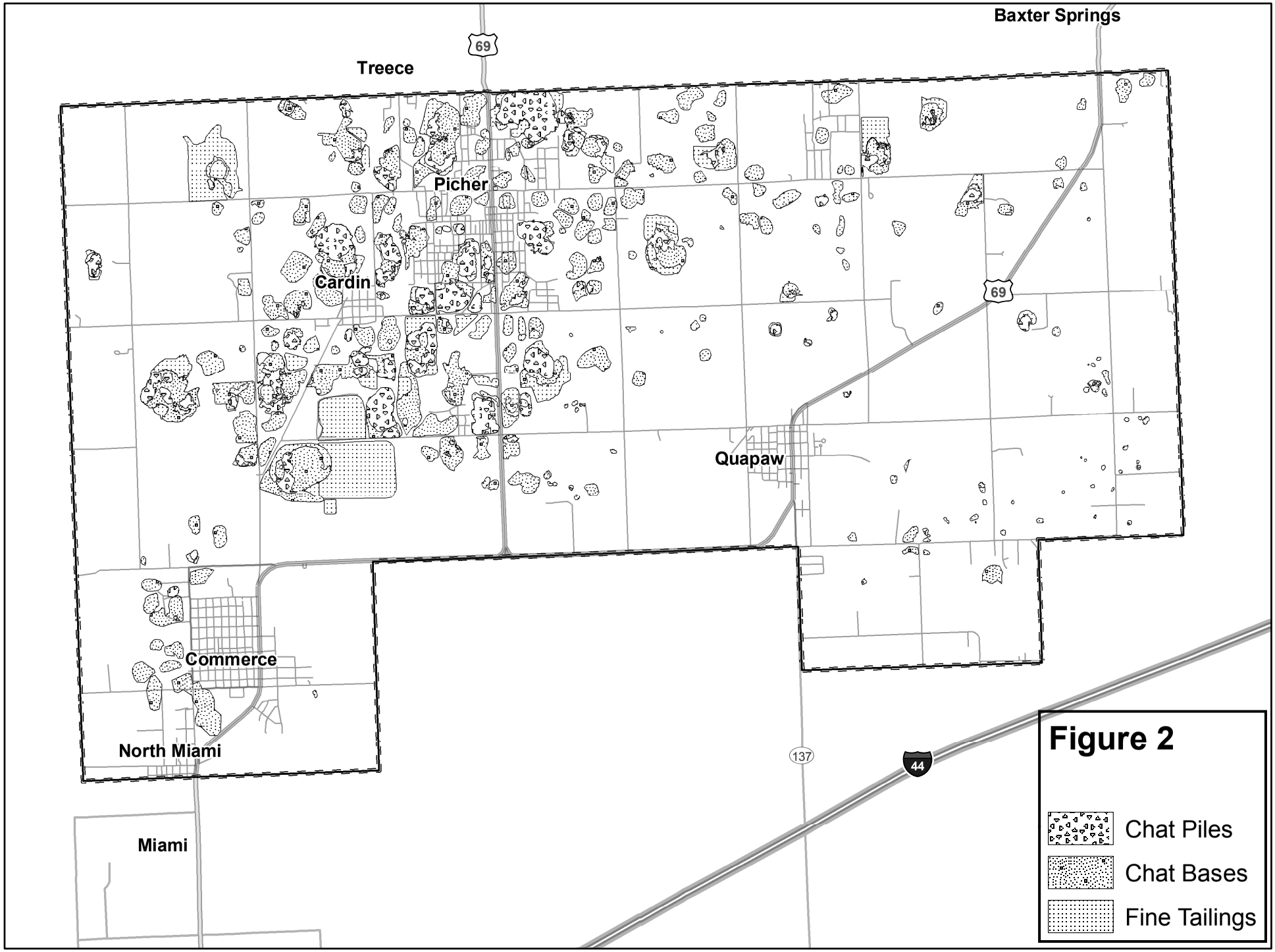
Treece
Picher
Cardin
69
Quapaw
Commerce
North Miami
137
44
Miami
Figure 1
OU 4 Boundary


Baxter Springs
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North Miami
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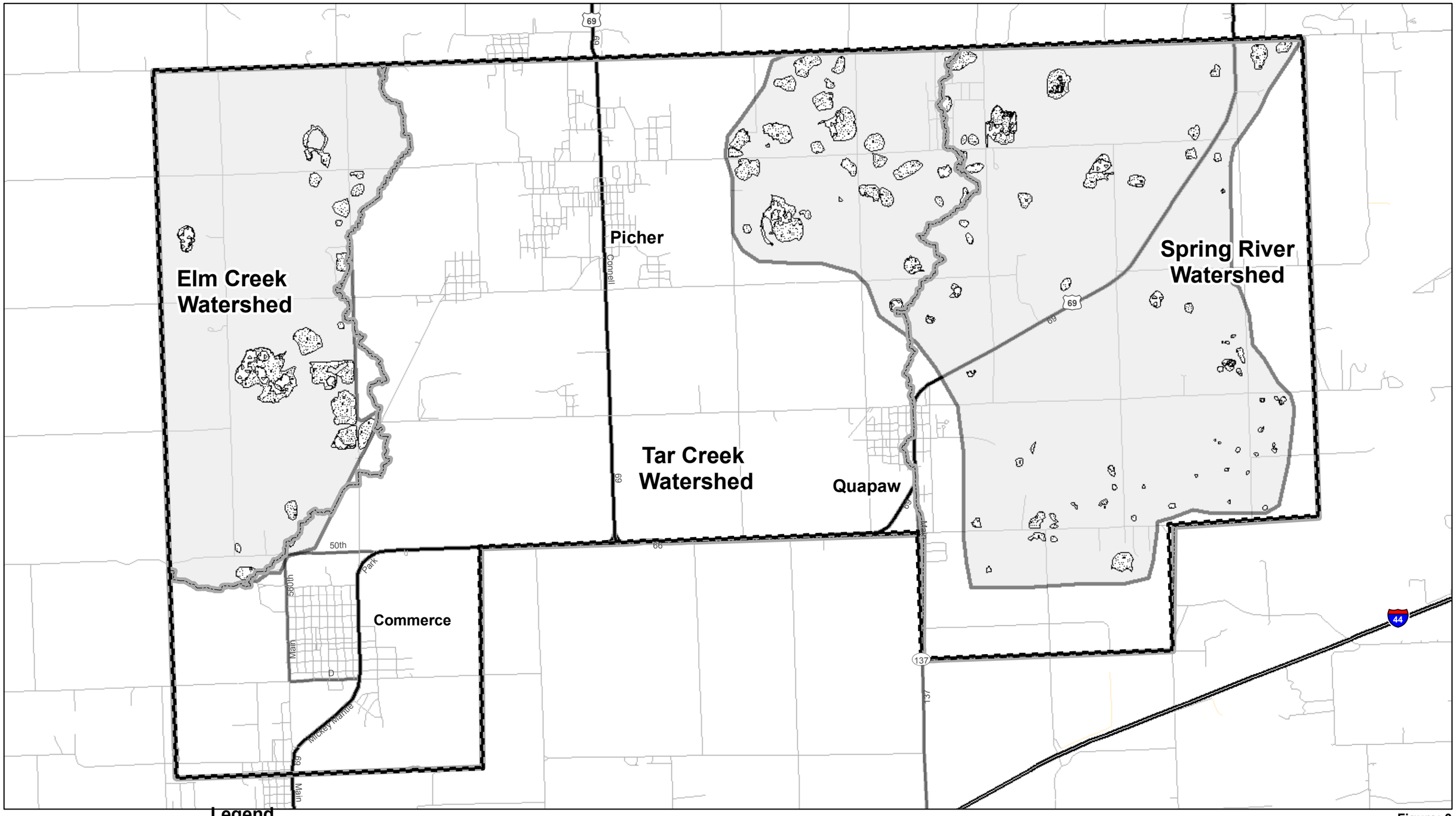
Figure 2
Chat Piles
Chat Bases
Fine Tailings



Legend

- Chat Piles
- Chat Bases
- Site Boundary
- Distal Zones
- Watershed Boundary

N

0 2,500 5,000 10,000 Feet

Figure: 3
Tar Creek Distal Zones and Watersheds

File Path: \\chuckwagon\GIS\NWOFiles\Tar Creek\MXD\MAY 2007 FS Report\All Distal Zones.mxd, Date: May 02, 2007

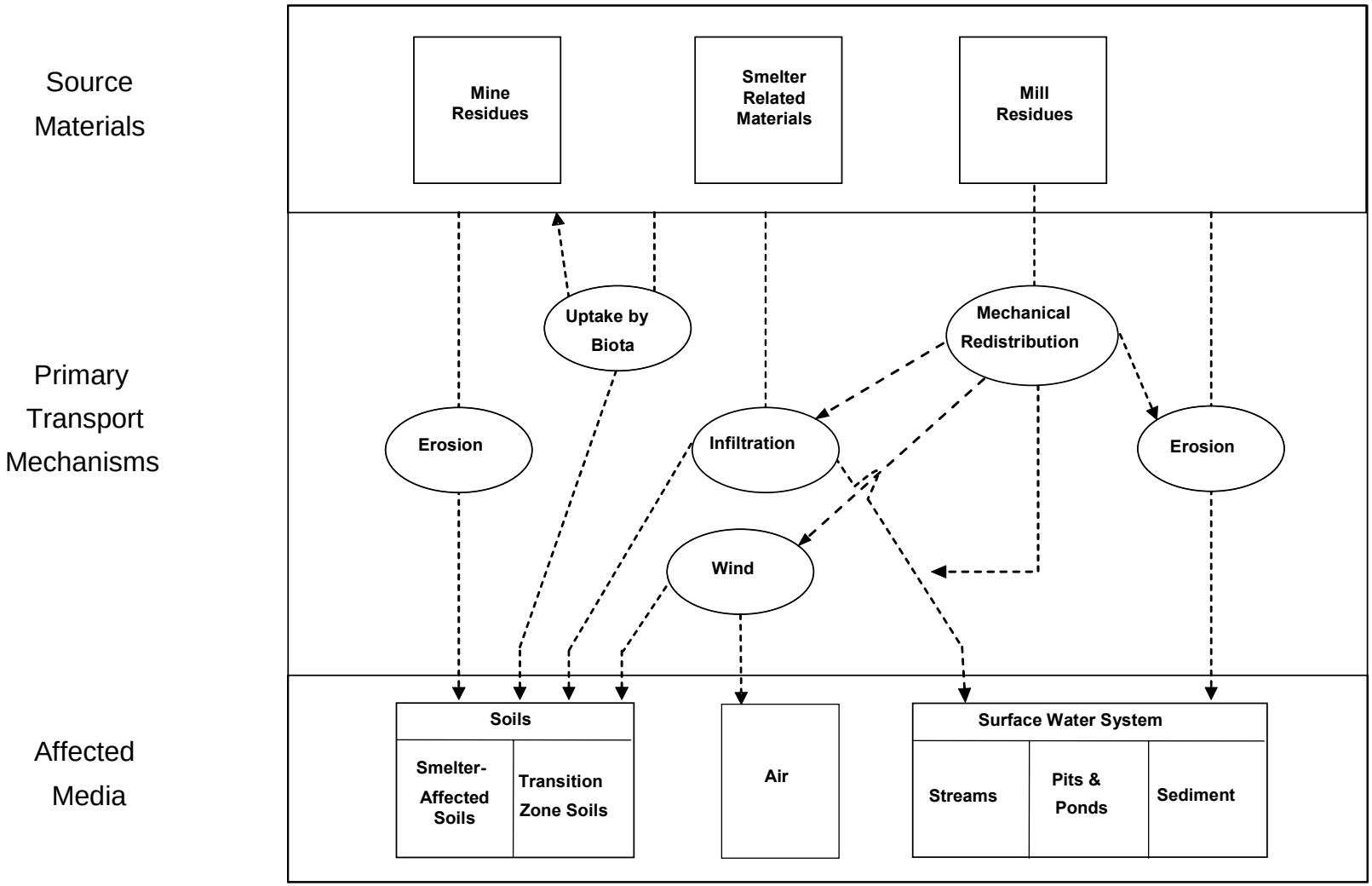
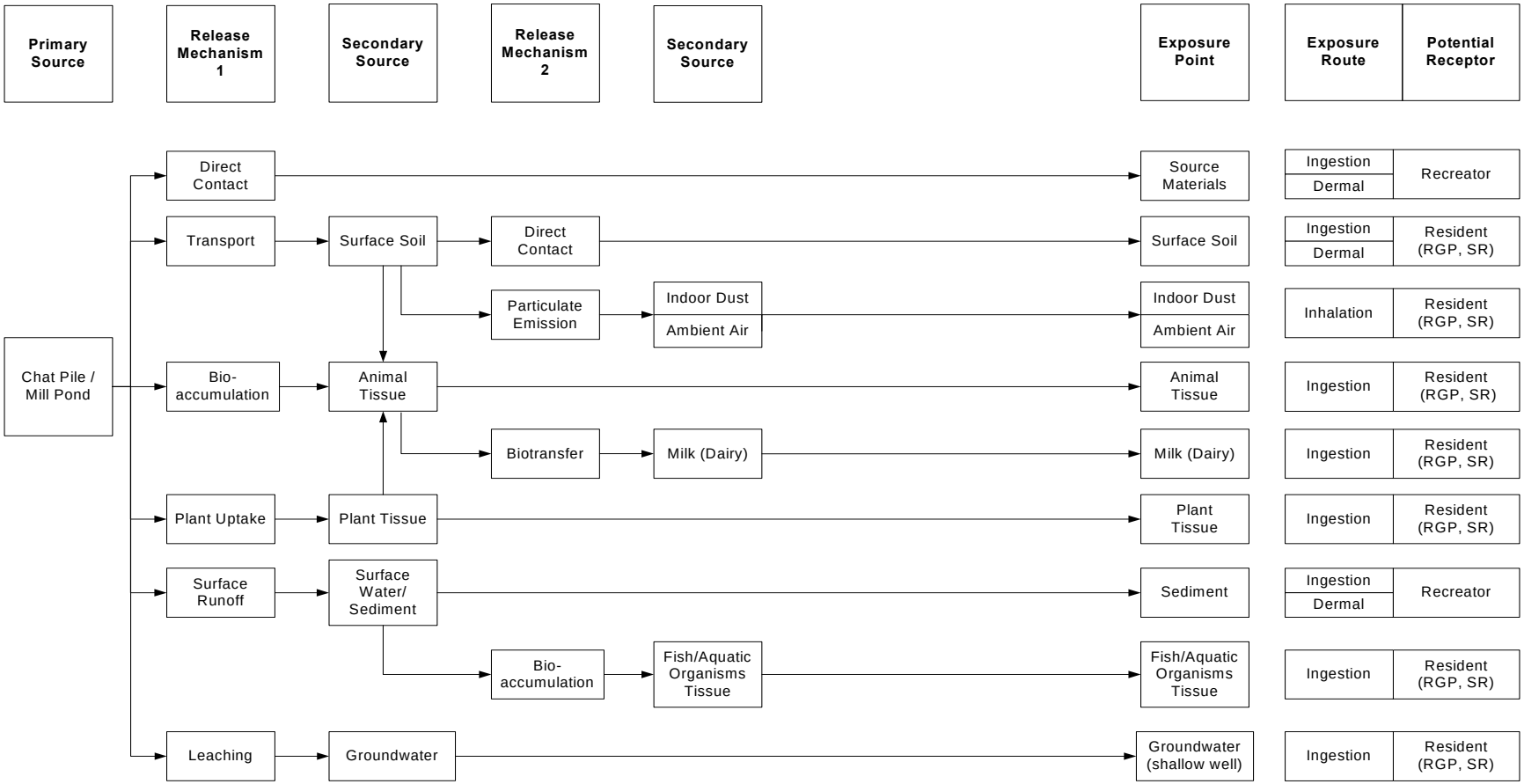


Figure 4 Source Materials, Transport Mechanisms, and Affected Media



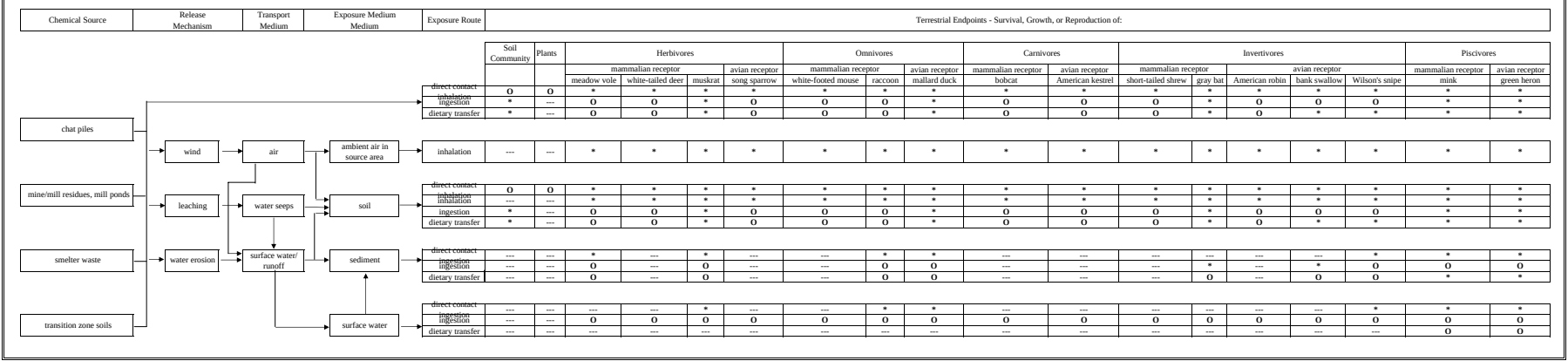
SR - Subsistence Resident
RGP - Rural General Public

Conceptual Site Model for HHRA
Tar Creek OU4, Miami, OK

Figure 5

Figure 6. Conceptual Site Model and Terrestrial Endpoints Evaluated under OU4

Tar Creek Site
Ottawa County, Oklahoma



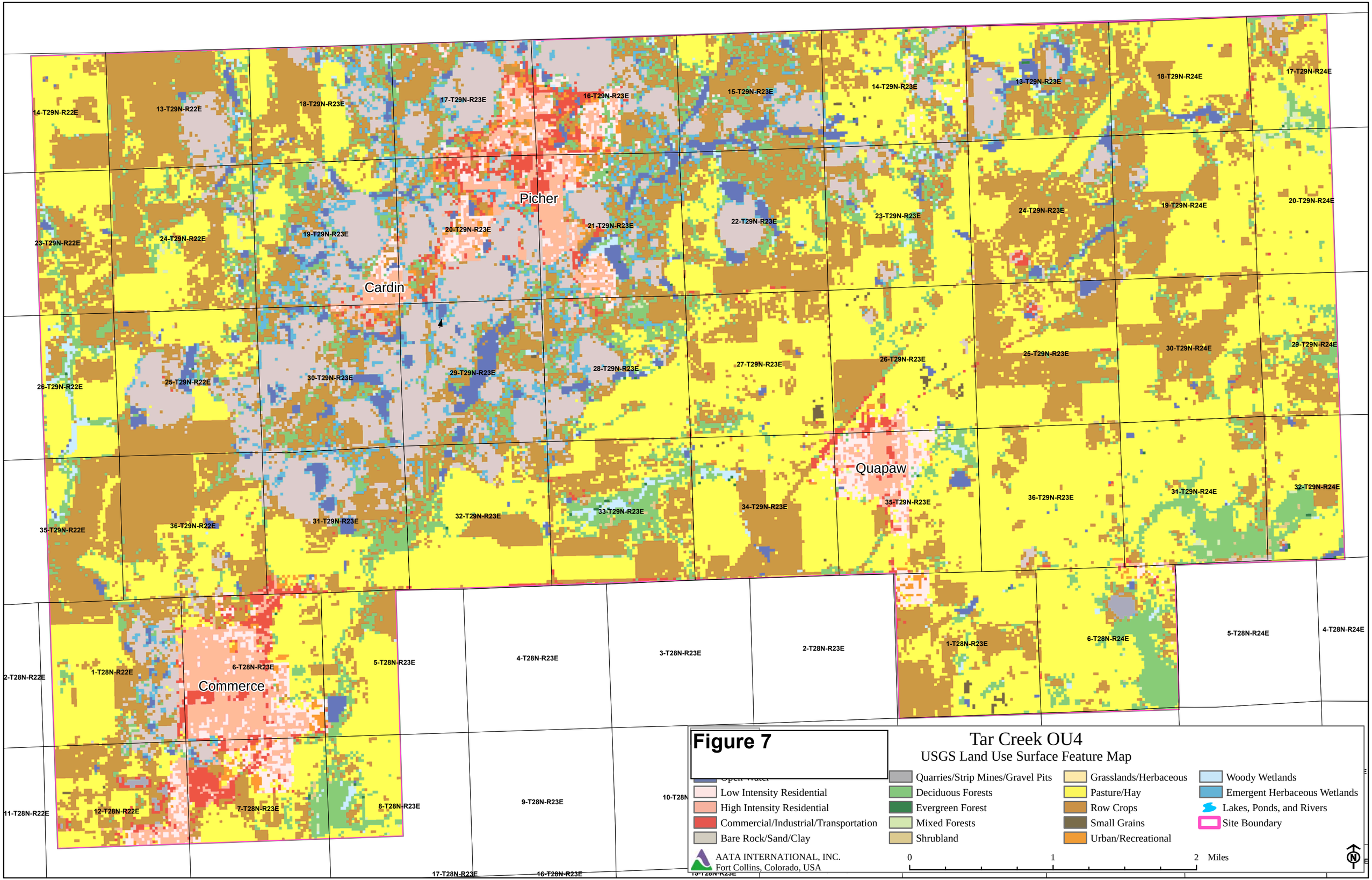
Chemical Source	Release Mechanism	Transport Medium	Exposure Medium	Exposure Route	Terrestrial Endpoints - Survival, Growth, or Reproduction of:																		
					Soil Community	Plants	Herbivores				Omnivores			Carnivores		Invertivores						Piscivores	
							mammalian receptor			avian receptor	mammalian receptor		avian receptor	mammalian receptor	avian receptor	mammalian receptor		avian receptor			mammalian receptor	avian receptor
							meadow vole	white-tailed deer	muskrat	song sparrow	white-footed mouse	raccoon	mallard duck	bobcat	American kestrel	short-tailed shrew	gray bat	American robin	bank swallow	Wilson's snipe	mink	green heron
chat piles				direct contact	O	O	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
				inhalation	*	---	O	O	*	O	O	O	*	O	O	O	*	O	O	O	*	*
				ingestion	*	---	O	O	*	O	O	O	*	O	O	O	*	O	*	*	*	*
				dietary transfer	*	---	O	O	*	O	O	O	*	O	O	O	*	O	*	*	*	*
	wind	air	ambient air in source area	inhalation	---	---	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
mine/mill residues, mill ponds				direct contact	O	O	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	leaching	water seeps	soil	inhalation	---	---	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
				ingestion	*	---	O	O	*	O	O	O	*	O	O	O	*	O	O	O	*	*
				dietary transfer	*	---	O	O	*	O	O	O	*	O	O	O	*	O	*	*	*	*
smelter waste	water erosion	surface water/ runoff	sediment	direct contact	---	---	*	---	*	---	---	*	*	---	---	---	---	---	---	*	*	*
				ingestion	---	---	O	---	O	---	---	O	O	---	---	---	*	---	*	O	O	O
				dietary transfer	---	---	O	---	O	---	---	O	O	---	---	---	O	---	O	O	*	*
transition zone soils		surface water		direct contact	---	---	---	---	*	---	---	*	*	---	---	---	---	---	---	*	*	*
				ingestion	---	---	O	O	O	O	O	O	O	O	---	O	O	O	O	O	O	O
				dietary transfer	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	O	O

OU: Operational unit

- Pathway not complete or applicable, no evaluation necessary.

* Pathway is or may be complete; however, risk is likely low. Pathway not evaluated in Ecological Risk Assessment.

O Pathway is complete and risk may be significant. Pathway evaluated in Ecological Risk Assessment.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1-T28N-R22E
6-T28N-R23E
5-T28N-R23E
4-T28N-R23E
3-T28N-R23E
2-T28N-R23E
1-T28N-R23E
6-T28N-R24E
5-T28N-R24E
4-T28N-R24E
Commerce
11-T28N-R22E
12-T28N-R22E
7-T28N-R23E
8-T28N-R23E
9-T28N-R23E
10-T28N
17-T28N-R23E
16-T28N-R23E
Figure 7
Tar Creek OU4
USGS Land Use Surface Feature Map
Low Intensity Residential
High Intensity Residential
Commercial/Industrial/Transportation
Bare Rock/Sand/Clay
Quarries/Strip Mines/Gravel Pits
Deciduous Forests
Evergreen Forest
Mixed Forests
Shrubland
Grasslands/Herbaceous
Pasture/Hay
Row Crops
Small Grains
Urban/Recreational
Woody Wetlands
Emergent Herbaceous Wetlands
Lakes, Ponds, and Rivers
Site Boundary
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
0
1
2 Miles
N

Picher
Cardin
Quapaw
Commerce
Empire District Electric Co.
Tri-State Paving/Asphalt
Mini Storage
Chicken Farm
Junk Yard
Car Junk Yard
Umicore Optical Materials USA Inc.
Eagle Picher
Gallium Compounds
Picher Public Works
Picher Water Holding Ponds
KGI Wireless & Satellite
Town of Cardin
Teeter's Asphalt
Cardin Water Holding Ponds
Wiseda LTD, Subsidiary of Davoil Inc.
Garner's Wrecking Service
Rascal's Truck Stop
Dump Yard
Quapaw Water Holding Ponds
Quapaw Water Tower
Trailer Sales
Mini Storage
Quapaw Environmental Services
Beaver Springs Park
Midwest Mineral Limestone Stockpile
Commerce Water Holding Ponds
Trailer Junk Yard
Mushroom Farm
14-T29N-R22E
13-T29N-R22E
18-T29N-R23E
17-T29N-R23E
16-T29N-R23E
15-T29N-R23E
14-T29N-R23E
13-T29N-R23E
18-T29N-R24E
17-T29N-R24E
19-T29N-R24E
20-T29N-R24E
23-T29N-R22E
24-T29N-R22E
19-T29N-R23E
20-T29N-R23E
21-T29N-R23E
22-T29N-R23E
23-T29N-R23E
24-T29N-R23E
25-T29N-R22E
30-T29N-R22E
29-T29N-R23E
28-T29N-R23E
27-T29N-R23E
26-T29N-R23E
25-T29N-R23E
30-T29N-R24E
29-T29N-R24E
35-T29N-R22E
36-T29N-R22E
31-T29N-R23E
32-T29N-R23E
33-T29N-R23E
34-T29N-R23E
35-T29N-R23E
36-T29N-R23E
31-T29N-R24E
32-T29N-R24E
2-T28N-R22E
1-T28N-R22E
6-T28N-R23E
5-T28N-R23E
4-T28N-R23E
3-T28N-R23E
2-T28N-R23E
1-T28N-R23E
6-T28N-R24E
5-T28N-R24E
4-T28N-R24E
11-T28N-R22E
12-T28N-R22E
7-T28N-R23E
8-T28N-R23E
9-T28N-R23E
10-T28N-R23E
11-T28N-R23E
14-T28N-R23E
13-T28N-R23E
18-T28N-R24E

Figure 8

Tar Creek OU4
Land Use Surface Feature Map

Reclaimed Chat Base
- Development Rock
- Mill Residues (Chat Piles, Chat Bases, Fine Tailings, and Ponds)
- Smelter Wastes
- Total
- Partial

Land Use
- Industrial
- Commercial
- Municipal
- Agricultural (Crop Farming, Pasture Land)
- Rural Residences
- Historical Mill Locations
- Railroads
- Lakes, Ponds, and Rivers
- Tribal Land Boundaries
- Site Boundary

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

0 1 2 Miles

N

KANSAS

OKLAHOMA

PICHER

HOCKERVILLE

CARDIN

QUAPAW

Alternate 69

69

Connell

50th

560th

Park

66

Main

137

Legend

- Site Boundary
- City Boundaries
- Relocation Assistance Boundary

N

0 2,500 5,000 10,000 Feet

Adopted by the Lead-Impacted Communities Relocation Assistance Trust on August 1, 2006

Figure: 9

Relocation Assistance Zone

Operable Unit 4

LEGEND

OU 4 Streams

Edge Needing Possible Control

Near Stream Chat Pile or Chat Base

N

0 500 1,000 2,000 Feet

Figure 10
Estimated Source and Seepage Control Locations

Operable Unit 4

TREECE

PICHER

CARDIN

QUAPAW

COMMERCE

NORTH MIAMI

Alternate 69

69

Connell

50th

560th

Park

Main

D

Mickey Mantle

66

137

44

Legend

- Fine Tailings Proposed for Covering
- Fine Tailings Proposed for Injection
- Site Boundary

N

0 2,500 5,000 10,000 Feet

Figure: 11

Fine Tailing Locations and Proposed Disposition

Operable Unit 4

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations (EPCs)

Scenario Timeframe: Current/Future
Medium: Chat and Tailings Material
Exposure Medium: Chat and Tailings

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Surface Material (0-6 inches)	Lead	175	39600	mg/kg	97/97	3461	Mean

Scenario Timeframe: Current/Future
Medium: Surface Soil (residential, rural areas, and transition zone)
Exposure Medium: Animal Tissue

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Surface Soil (residential, rural areas, and transition zone)	Cadmium	0.5	248	mg/kg	249 / 261	27.4	97.5%
	Lead	10.5	4450	mg/kg	316 / 317	441	97.5%
	Zinc	38	39200	mg/kg	260 / 261	5390	97.5%

Scenario Timeframe: Current
Medium: Surface Soil (General Public)
Exposure Medium: Surface Soil

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Surface Soil (0-1 inch) in Yards owned by the General Public	Cadmium	0.5	47.5	mg/kg	164/172	47.5	Max
	Lead	10.9	822	mg/kg	171/172	(1)	
	Zinc	38	7700	mg/kg	171/172	7700	Max

(1) concentration at the individual yard was used as EPC.

Scenario Timeframe: Current
Medium: Chat Pile Material and Tailings
Exposure Medium: Ambient Air

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Ambient Air	Cadmium	0.000002	0.00020	ug/m3	--	0.00008	99%
	Zinc	0.00075	0.043	ug/m3	--	0.017	99%

Scenario Timeframe: Current
Medium: Surface Soil (Subsistence)
Exposure Medium: Surface Soil

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Surface Soil (0-1 inch) in Yards at Native American-owned property	Cadmium	0.6	9.6	mg/kg	6/9	9.6	Max
	Lead	26.6	135	mg/kg	9/9	(1)	
	Zinc	47	1940	mg/kg	9/9	1940	Max

(1) concentration at the individual yard was used as EPC.

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations (EPCs)

Scenario Timeframe:	Current/Future						
Medium:	Groundwater						
Exposure Medium:	Groundwater						
		Concentrations			Frequency of		EPC
Exposure Point	**COCs**	*Min*	*Max*	**Units**	**Detection**	**EPC**	**Basis**
Private Wells at properties owned by the General Public	Cadmium	0.0001	0.003	mg/L	16 / 25	0.003	Max
	Zinc	0.02	1.11	mg/L	22 / 25	1.11	Max

(2) concentration at the individual well was used as EPC.

Scenario Timeframe:	Current/Future						
Medium:	Groundwater						
Exposure Medium:	Groundwater						
		Concentrations			Frequency of		EPC
Exposure Point	**COCs**	*Min*	*Max*	**Units**	**Detection**	**EPC**	**Basis**
Private Wells at properties at Native American-owned property	Zinc	0.19	0.22	mg/L	2 / 3	0.22	Max

Scenario Timeframe:	Current						
Medium:	Transition Zone Soil						
Exposure Medium:	Asparagus (Above Ground)						
		Concentrations			Frequency of		EPC
Exposure Point	**COCs**	*Min*	*Max*	**Units**	**Detection**	**EPC**	**Basis**
Asparagus (above-ground portion), unwashed plant	Cadmium	0.6707	21.333	mg/kg	19/19	5.48	95%
	Lead	0.447	62.01	mg/kg	19/19	18.8	Mean
	Zinc	23.3758	409.5	mg/kg	19/19	142	95%

Scenario Timeframe:	Current						
Medium:	Transition Zone Soil						
Exposure Medium:	Asparagus (Root)						
		Concentrations			Frequency of		EPC
Exposure Point	**COCs**	*Min*	*Max*	**Units**	**Detection**	**EPC**	**Basis**
Asparagus (root portion), unwashed plant	Cadmium	4.4243	25.915	mg/kg	19/19	12.5	95%
	Lead	19.5048	1387.44	mg/kg	19/19	558	Mean
	Zinc	234.107	3578.58	mg/kg	19/19	1400	95%

Scenario Timeframe:	Current						
Medium:	Transition Zone Soil						
Exposure Medium:	Willow (Above Ground)						
		Concentrations			Frequency of		EPC
Exposure Point	**COCs**	*Min*	*Max*	**Units**	**Detection**	**EPC**	**Basis**
Willow (above-ground portion), unwashed plant	Cadmium	1.1515	32.2588	mg/kg	19/19	17.8	95%
	Lead	0.5226	20.213	mg/kg	17/19	10.9	Mean
	Zinc	67.445	705.55	mg/kg	19/19	467	95%

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations (EPCs)

Scenario Timeframe: Current
Medium: Transition Zone Soil
Exposure Medium: Willow (Root)

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Willow (root portion), unwashed plant	Cadmium	4.8909	132.818	mg/kg	19/19	49.7	95%
	Lead	15.8912	1922.46	mg/kg	19/19	1024	Mean
	Zinc	466.04	13202	mg/kg	19/19	4620	95%

Scenario Timeframe: Current
Medium: Transition Zone Soil
Exposure Medium: Cattail (Above Ground)

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Cattail (above-ground portion), unwashed plant stalk	Cadmium	0.02755	34.17	mg/kg	14/19	19.8	99%
	Lead	0.29	1366.8	mg/kg	17/19	287	Mean
	Zinc	13.9518	4411.5	mg/kg	19/19	2560	99%

Scenario Timeframe: Current
Medium: Transition Zone Soil
Exposure Medium: Cattail (Root)

Exposure Point	COCs	Concentrations Min	Concentrations Max	Units	Frequency of Detection	EPC	EPC Basis
Cattail (root portion), unwashed plant	Cadmium	0.04185	249.426	mg/kg	19/19	61.1	95%
	Lead	0.8601	2759.77	mg/kg	19/19	1076	Mean
	Zinc	17.825	18414	mg/kg	19/19	4360	95%

Table 2

Summary of General Public Resident Exposure Parameters based on Reasonable Maximum Exposure.

Exposure Point	Exposure Route	Parameter Code	Parameter Definition	Units	Resident (General Public)	
					Adult	Child
Surface Soil (0-1 inch)	Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-specific	Chemical-specific
		IR-S	Ingestion Rate of Soil	mg/day	100	200 †
		EF	Exposure Frequency	days/year	350	350
		ED	Exposure Duration	years	24	6 †
		CF1	Conversion Factor 1	kg/mg	1.0E-06	1.0E-06
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	8,760	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		IR-S-Adj	Ingestion Rate of Soil, Age-adjusted †	mg-year/kg-day	114.29	--
	Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-specific	Chemical-specific
		SA	Skin Surface Area Available for Contact	cm^2	5,700	2,800 †
		SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.07	0.2 †
		DABS	Dermal Absorption Factor Solids	--	Chemical-specific	Chemical-specific
		CF1	Conversion Factor 1	kg/mg	1.0E-06	1.0E-06
		EF	Exposure Frequency	days/year	350	350
		ED	Exposure Duration	years	24	6 †
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	8,760	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		DA-Adj	Dermal Absorption, Age-adjusted †	mg-year/kg-day	361	--
Private Wells	Ingestion	CW	Chemical Concentration in Water	µg/l	Chemical-specific	Chemical-specific
		IR-W	Ingestion Rate of Water	liters/day	2	1 †
		EF	Exposure Frequency	days/year	350	350
		ED	Exposure Duration	years	24	6 †
		CF2	Conversion Factor 2	mg/µg	1.0E-03	1.0E-03
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	8,760	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		IR-W-Adj	Ingestion Rate of Water, Age-adjusted †	liter-year/kg-day	1.1	--
Ambient Air	Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical-specific	Chemical-specific
		IN	Inhalation Rate	m^3/day	20	10 †
		EF	Exposure Frequency	days/year	350	350
		ED	Exposure Duration	years	24	6 †
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	8,760	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		IN-Adj	Inhalation Rate, Age-adjusted †	m^3/hour	10.9	--

Note:

† Child exposure factors were used to calculate age-adjusted exposure values.

Table 3

Summary of Subsistence Resident Exposure Parameters based on Reasonable Maximum Exposure.

Exposure Point	Exposure Route	Parameter Code	Parameter Definition	Units	Resident (Subsistence)	
					Adult	Child
Surface Soil (0-1 inch)	Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-specific	Chemical-specific
		IR-S	Ingestion Rate of Soil	mg/day	400	400 †
		EF	Exposure Frequency	days/year	365	365
		ED	Exposure Duration	years	70	6 †
		CF1	Conversion Factor 1	kg/mg	1.0E-06	1.0E-06
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	25,550	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		IR-S-Adj	Ingestion Rate of Soil, Age-adjusted †	mg-year/kg-day	526	--
	Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-specific	Chemical-specific
		SA	Skin Surface Area Available for Contact	cm^2	5,700	2,800 †
		SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.07	0.2 †
		DABS	Dermal Absorption Factor Solids	--	Chemical-specific	Chemical-specific
		CF1	Conversion Factor 1	kg/mg	1.0E-06	1.0E-06
		EF	Exposure Frequency	days/year	365	365
		ED	Exposure Duration	years	70	6 †
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	25,550	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		DA-Adj	Dermal Absorption, Age-adjusted †	mg-year/kg-day	589	--
Small Game (Bird, Rabbit)	Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-specific	--
		BAF-SMG	Bio-accumulation Factor -Small Game	kg/kg	Chemical-specific	--
		IR-SMG	Ingestion Rate -Small Game	kg/day	0.05	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Beef (Cattle)	Ingestion	C_{beef}	Chemical Concentration in Beef	mg/kg	Chemical-specific	--
		BAF-BEEF	Bio-accumulation Factor - Beef	kg/kg	Chemical-specific	--
		IR-BEEF	Ingestion Rate - Beef	kg/day	F: 0.1; B: 0.885	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Milk (Dairy)	Ingestion	C-DM	Chemical Concentration in Milk (Dairy)	µg/l	--	Chemical-specific
		IR-DM	Ingestion Rate of Milk (Dairy)	liters/day	--	0.5
		EF	Exposure Frequency	days/year	--	365
		ED	Exposure Duration	years	--	6
		CF2	Conversion Factor 2	mg/µg	--	1.0E-03
		BW	Body Weight	kg	--	15
		AT-N	Averaging Time (Non-Cancer)	days	--	2,190
		AT-C	Averaging Time (Cancer)	days	--	25,550
Ambient Air	Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical-specific	Chemical-specific
		IN	Inhalation Rate	m^3/day	30	10 †
		EF	Exposure Frequency	days/year	365	365
		ED	Exposure Duration	years	70	6 †
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	25,550	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	--
		IN-Adj	Inhalation Rate, Age-adjusted †	m^3/hour	31.4	--

Table 3

Summary of Subsistence Resident Exposure Parameters based on Reasonable Maximum Exposure.

Exposure Point	Exposure Route	Parameter Code	Parameter Definition	Units	Resident (Subsistence)	
					Adult	Child
Private Wells	Ingestion	CW	Chemical Concentration in Water	µg/l	Chemical-specific	Chemical-specific
		IR-W	Ingestion Rate of Water	liters/day	4	1 †
		EF	Exposure Frequency	days/year	365	365
		ED	Exposure Duration	years	70	6 †
		CF2	Conversion Factor 2	mg/µg	1.0E-03	1.0E-03
		BW	Body Weight	kg	70	15 †
		AT-N	Averaging Time (Non-Cancer)	days	25,550	2,190
		AT-C	Averaging Time (Cancer)	days	25,550	25,550
		IR-W-Adj	Ingestion Rate of Water, Age-adjusted †	liter-year/kg-day	4.1	--
Fish Tissue	Ingestion	C_{fish}	Chemical Concentration in Fish Tissue	mg/kg-fish	Chemical-specific	--
		IR-F	Fish Ingestion Rate	kg-fish/day	F: 0.885; B: 0.075	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Aquatic Food Tissue (Mussels etc.)	Ingestion	C_{sed}	Chemical Concentration in Sediment	mg/kg-sed	Chemical-specific	--
		BAF-AI	Bio-accumulation Factor (Aquatic Invertebrates)	kg/kg-tissue	Chemical-specific	--
		IR-AF	Aquatic Food (Mussels, Crayfish) Ingestion Rate	kg-food/day	0.175	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Asparagus	Ingestion	C_{plant1}	Chemical Concentration in Asparagus (above ground)	mg/kg	Chemical-specific	--
		$C_{plant1\text{-}root}$	Chemical Concentration in Asparagus (root).	mg/kg	Chemical-specific	--
		IR-P1	Ingestion Rate -Asparagus (above ground)	kg/day	0.27	--
		$IR\text{-}P1_{root}$	Ingestion Rate -Asparagus (root)	kg/day	0.27	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Willow	Ingestion	C_{plant2}	Chemical Concentration in Willow (above ground)	mg/kg	Chemical-specific	--
		$C_{plant2\text{-}root}$	Chemical Concentration in Willow (root).	mg/kg	Chemical-specific	--
		IR-P2	Ingestion Rate -Willow (above ground)	kg/day	0.27	--
		$IR\text{-}P2_{root}$	Ingestion Rate -Willow (root)	kg/day	0.27	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--
Cattail	Ingestion	C_{plant3}	Chemical Concentration in Cattail (above ground)	mg/kg	Chemical-specific	--
		$C_{plant3\text{-}root}$	Chemical Concentration in Cattail (root).	mg/kg	Chemical-specific	--
		IR-P3	Ingestion Rate -Cattail (above ground)	kg/day	0.27	--
		$IR\text{-}P3_{root}$	Ingestion Rate -Cattail (root)	kg/day	0.27	--
		EF	Exposure Frequency	days/year	365	--
		ED	Exposure Duration	years	70	--
		BW	Body Weight	kg	70	--
		AT-N	Averaging Time (Non-Cancer)	days	25,550	--
		AT-C	Averaging Time (Cancer)	days	25,550	--

Note:

F - high fish diet; B - high beef diet

† Child exposure factors were used to calculate age-adjusted exposure values.

Table 4

Summary of Adolescent Recreator Exposure Parameters based on Reasonable Maximum Exposure.

Exposure Point	Exposure Route	Parameter Code	Parameter Definition	Units	Recreator
					Adolescent
Chat Pile & Tailings Ponds Surface (0-6 inch)	Ingestion	CM	Chemical Concentration in Material	mg/kg	Chemical-specific
		IR-S	Ingestion Rate of Material	mg/day	100
		EF	Exposure Frequency	days/year	184
		ED	Exposure Duration	years	11
		CF1	Conversion Factor 1	kg/mg	1.0E-06
		BW	Body Weight	kg	47
		AT-C	Averaging Time (Cancer)	days	25,550
		AT-N	Averaging Time (Non-Cancer)	days	4,015
	Dermal	CM	Chemical Concentration in Material	mg/kg	Chemical-specific
		SA	Skin Surface Area Available for Contact	cm^2	5,300
		SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.07
		DABS	Dermal Absorption Factor Solids	--	Chemical-specific
		CF1	Conversion Factor 1	kg/mg	1.0E-06
		EF	Exposure Frequency	days/year	184
		ED	Exposure Duration	years	11
		BW	Body Weight	kg	47
		AT-C	Averaging Time (Cancer)	days	25,550
		AT-N	Averaging Time (Non-Cancer)	days	4,015

Table 5

Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Concern	Oral Cancer Slope Factor	Dermal Cancer Slope Factor	Slope Factor Units	Weight of Evidence/Cancer Guidance Description	Source	Date: (MM/DD/YYYY)
Cadmium	--	--	--	B1	IRIS	10/10/2005
Zinc	--	--	--	D	IRIS	10/10/2005
Lead	--	--	--	B2	IRIS	10/10/2005

Pathway: Inhalation

Chemical of Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/Cancer Guidance Description	Source	Date: (MM/DD/YYYY)
Cadmium	1.8E-03	$(\mu g/m^3)^{-1}$	6.3E+00	$(mg/kg\text{-}day)^{-1}$	B1	IRIS	10/10/2005
Zinc	--	--	--	--	D	IRIS	10/10/2005
Lead	--	--	--	--	B2	IRIS	10/10/2005

Key

-- : No information available

IRIS: Integrated Risk Information System, U.S. EPA

Weight of Evidence definitions:

- A - Human carcinogen
- B1 - Probable human carcinogen - Indicates that limited human data are available
- B2 - Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans
- C - Possible human carcinogen
- D - Not classifiable as a human carcinogen
- E - Evidence of noncarcinogenicity

Table 6

Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YYYY)
Cadmium (water)	Chronic	5.0E-04	mg/kg-day	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	10/10/2005
Cadmium (food)	Chronic	1.0E-03	mg/kg-day	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	10/10/2005
Zinc	Chronic	3.0E-01	mg/kg-day	3.0E-01	mg/kg-day	Circulatory	3/1	IRIS	10/10/2005
Lead	--	--	--	--	--	--	--	--	--

Pathway: Inhalation

Chemical of Concern	Chronic/ Subchronic	Inhalation RfC	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfC:RfD: Target Organ	Dates: (MM/DD/YYYY)
Cadmium	Chronic	2.0E-04	mg/m^3	5.7E-05	mg/kg-day	Kidney	10	NCEA	6/14/1998
Zinc	Chronic	NA	NA	NA	NA	NA	NA	IRIS	10/10/2005
Lead	--	--	--	--	--	--	--	--	--

Key

-- : No information available

IRIS: Integrated Risk Information System, U.S. EPA

Table 7

Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Current
Receptor Population: Residential (General Public)
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil (Yards)	Surface Soil (0-1 inch)	Cadmium	Kidney	6.1E-01	NA	6.8E-02	6.8E-01
			Zinc	Circulatory	3.3E-01	NA	9.2E-04	3.3E-01
							Surface Soil Hazard Index Total =	1.0E+00
Chat and Tailings Material	Ambient Air	Ambient Air	Cadmium	Kidney	NA	9.1E-04	NA	9.1E-04
			Zinc	N/A	NA	NA	NA	NA
							Chat and Tailings Hazard Index Total =	9.1E-04
Groundwater	Groundwater	Private Wells	Cadmium	Kidney	3.8E-01	NA	NA	3.8E-01
			Zinc	Circulatory	2.4E-01	NA	NA	2.4E-01
							Groundwater Hazard Index Total =	6.2E-01
							Receptor Hazard Index =	1.6E+00
							Circulatory Hazard Index =	5.7E-01
							Kidney Hazard Index =	1.1E+00

Scenario Timeframe: Current/Future
Receptor Population: Residential (Subsistence)
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil (Yards)	Surface Soil (0-1 inch)	Cadmium	Kidney	5.5E-02	NA	2.2E-03	5.7E-02
			Zinc	Circulatory	3.7E-02	NA	3.7E-05	3.7E-02
							Surface Soil Hazard Index Total =	9.4E-02
Chat and Tailings Material	Ambient Air	Ambient Air	Cadmium	Kidney	NA	6.1E-04	NA	6.1E-04
			Zinc	N/A	NA	NA	NA	NA
							Chat Pile Material and Tailings Hazard Index Total =	6.1E-04
Surface Soil (residential, smelter, transition zone)	Animal Tissue	Small Game (Bird, Rabbit)	Cadmium	Kidney	4.4E-04	NA	NA	4.4E-04
			Zinc	Circulatory	6.7E-05	NA	NA	6.7E-05
		Beef (Cattle) * high fish diet	Cadmium	Kidney	1.8E-08	NA	NA	1.8E-08
			Zinc	Circulatory	6.5E-09	NA	NA	6.5E-09
		Beef (Cattle) * high Beef diet	Cadmium	Kidney	1.6E-07	NA	NA	1.6E-07
			Zinc	Circulatory	5.8E-08	NA	NA	5.8E-08
							Surface Soil (residential, smelter, transition zone) Hazard Index Total (High Fish Diet) =	5.0E-04
							Surface Soil (residential, smelter, transition zone) Hazard Index Total (HIgh Beef Diet) =	5.0E-04

Table 7

Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Current
Receptor Population: Residential (General Public)
Receptor Age: Child

Transition Zone	Plant Tissue	Asparagus (above ground)	Cadmium	Kidney	2.1E+01	NA	NA	2.1E+01
			Zinc	Circulatory	1.8E+00	NA	NA	1.8E+00
		Asparagus (root)	Cadmium	Kidney	4.8E+01	NA	NA	4.8E+01
			Zinc	Circulatory	1.8E+01	NA	NA	1.8E+01
		Willow (above ground)	Cadmium	Kidney	6.9E+01	NA	NA	6.9E+01
			Zinc	Circulatory	6.0E+00	NA	NA	6.0E+00
		Willow (root)	Cadmium	Kidney	1.9E+02	NA	NA	1.9E+02
			Zinc	Circulatory	5.9E+01	NA	NA	5.9E+01
		Cattail (above ground)	Cadmium	Kidney	7.6E+01	NA	NA	7.6E+01
			Zinc	Circulatory	3.3E+01	NA	NA	3.3E+01
		Cattail (root)	Cadmium	Kidney	2.4E+02	NA	NA	2.4E+02
			Zinc	Circulatory	5.6E+01	NA	NA	5.6E+01
							Transition Zone Hazard Index Total =	8.2E+02
Aquatic Biota	Fish Tissue/ Aquatic Food	Aquatic Food Tissue (Mussels etc.)	Cadmium	Kidney	4.0E+00	NA	NA	4.0E+00
			Zinc	Circulatory	6.5E-01	NA	NA	6.5E-01
		Fish Tissue * high fish diet	Cadmium	Kidney	2.2E+00	NA	NA	2.2E+00
			Zinc	Circulatory	9.0E-01	NA	NA	9.0E-01
		Fish Tissue * high Beef diet	Cadmium	Kidney	1.8E-01	NA	NA	1.8E-01
			Zinc	Circulatory	7.6E-02	NA	NA	7.6E-02
							Aquatic Biota Total (High Fish Diet) =	7.7E+00
							Aquatic Biota Total (HIgh Beef Diet) =	5.0E+00
Groundwater	Groundwater	Groundwater	Zinc	Circulatory	4.2E-05	NA	NA	4.2E-05
							Groundwater Hazard Index Total =	4.2E-05
							Receptor Hazard Index (High Fish Diet) =	8.2E+02
							Receptor Hazard Index (High Beef Diet) =	8.2E+02
							Circulatory Hazard Index (High Fish Diet) =	**2E+02**
							Kidney Hazard Index (High Fish Diet) =	**6E+02**
							Circulatory Hazard Index (High Beef Diet) =	**2E+02**
							Kidney Hazard Index (High Beef Diet) =	**6E+02**

Table 8

Summary of Blood Lead Concentrations (PbBs) Risk Estimations (from ALM)

	Exposure Point Concentrations											Adult Lead Model Results	
Resident	Average Measured Soil Concentration (mg/kg)	Food lead concentration (Food Item 1 - Small Mammals) (ug/g)	Food lead concentration (Food Item 2 - Beef) (ug/g)	Food lead concentration (Food Item 3 - Aquatic Biota) (ug/g)	Food lead concentration (Food Item 4 - Fish) (ug/g)	Food lead concentration (Food Item 5 - Asparagus [above ground]) (ug/g)	Food lead concentration (Food Item 6 - Asparagus [root]) (ug/g)	Food lead concentration (Food Item 7 - Willow [above ground]) (ug/g)	Food lead concentration (Food Item 8 - Willow [root]) (ug/g)	Food lead concentration (Food Item 9 - Cattail [above ground]) (ug/g)	Food lead concentration (Food Item 10 - Cattail [root]) (ug/g)	Geo Mean	%Above target BLL
3 **	29.1	3.8E+02	1.2E-01	1.6E+00	4.3E-01	1.9E+01	5.6E+02	1.1E+01	1.0E+03	2.9E+02	1.1E+03	58,400	100%
5 **	88.4	3.8E+02	1.2E-01	1.6E+00	4.3E-01	1.9E+01	5.6E+02	1.1E+01	1.0E+03	2.9E+02	1.1E+03	58,400	100%
41	643.3	--	--	--	--	--	--	--	--	--	--	3.181	6.7%

Note:

** Resident on BIA land

Only 3 of 46 residential properties exceeded the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children exceeding 10 ug/dL blood lead are presented.

Table 9

Summary of Blood Lead Concentrations (PbBs) Risk Estimations (from IEUBK Model)

	Exposure Point Concentrations			IEUBK Model Results	
Resident	**Modeled Air Concentration (ug/m^3)**	**Average Measured Soil Concentration (mg/kg)**	**Average Measured Groundwater Concentration (ug/L)**	**Geo Mean**	**%Above target BLL**
26	0.000424	404.8	4 (1)	5.061	7.365
39	0.002348	491	4 (1)	5.749	11.943
41	0.004562	643.3	4 (1)	6.910	21.578

Note:

Only 3 of 46 residential properties exceeded the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children exceeding 10 ug/dL blood lead are presented.

(1) Default concentration of 4 ug/L was used for those residents without groundwater samples.

TABLE 10

Comparative Analysis of Remedial Alternatives with Respect to Cost
Tar Creek Superfund Site

Criterion	**Alternative 1** **No Further Action**	**Alternative 4** **Phased Consolidation, On-Site Disposal and Institutional Controls**	**Alternative 5** **Voluntary Relocation, Phased Consolidation, On-Site Disposal, and Institutional Controls**	**Alternative 8** **Total Source Consolidation, On-Site Disposal and Institutional Controls**
Direct Capital Costs	Not Calculated	$182,736,000	$224,794,000	$319,401,000
Indirect Capital Costs	Not Calculated	$107,641,000	$107,641,000	$159,574,000
Total Capital Costs	Not Calculated	$290,377,000	$332,435,000	$478,975,000
Operating and Maintenance Costs	Not Calculated	$375,000/year decreasing to $125,000/year	$375,000/year decreasing to $125,000/year	$475,000/year decreasing to $225,000/year
Net Present Value Assuming a 7% Discount Rate	**Not Calculated**	**$167,735,000**	**$167,288,000**	**$255,909,000**

TABLE 11 - ALTERNATIVE 5
VOLUNTARY RELOCATION

Item #	Item Description	Est. Quantity	Units	Est. Unit Cost	Estimated Cost	Cost Basis	Assumptions
1.	**Relocation Expenses**						
	1.1 Residential Houses	678	houses				Estimated quantity of residential home properties based upon update from ODEQ, 2007.
	a. Houses to be bought by state program (Phase I)	256	houses				Estimated quantity based upon update from LICRA, 2007,10/2/2007.
	b. Remaining houses addressed by Alternative 5	522	houses	$58,290.00	$30,427,380	State Buyout 2006	Remaining quantity of properties based upon update from LICRA (10/2/2007) plus 100 additional properties (422+100=522). Average cost of property $58,290 after 207 homes.
	c. Moving allowance	634	relocates	$1,000.00	$634,000	State Buyout 2006	Moving allowance of $1000 per household. Of the 487 remaining households, 112 are renters.
	d. Renters assistance	112	renters	$4,408.00	$493,696	State Buyout 2006	Current buyout average after 26 renters
	e. Demolition and disposal of remediated houses	417	houses	$5,500.00	$2,293,500		Based on State 2005 buyout, $5,500 per structure. State felt that cost differential likely would be offset by salvage/resale value.
	f. Demolition and disposal of non-remediated houses	105	houses	$5,500.00	$577,500	.	
	1.2 Commercial Properties	66	businesses				Estimated quantity of commercial properties based upon update from ODEQ, 2007.
	a. Commercial properties to be bought by state program (Phase I)	19	businesses				Estimated quantity based upon update from LICRA, 10/2/2007.
	b. Remaining commercial properties addressed by Alternative 5	47	businesses	$107,674.00	$5,060,678		Current buyout average of $107,674/property, after 19 commercial properties.
	c. Demolition and disposal of commercial properties	47	businesses	$11,000.00	$517,000	State Est.	Assumes double residential demolition cost.
	d. Moving allowance	47	businesses	$2,000.00	$94,000		State law provides $2,000 (max.) moving allowance for commercial properties.
	Subtotal Direct Capital Costs	**$40,097,754**					
2.	**LICRA Administration (Indirect) Costs**					EPA 2004	Assumes tasks in EPA 's SF Relocation SOW Template Model SOW (percentages are a proportion of the direct relocation costs).
	a. Task 1 - Planning	$0					
	b. Task 2 - Coordination and Communication	$0					
	c. Task 3 - Advisory Services	$0					
	d. Task 4 - Appraisal and Acquisition	$1,328,340					State contract: $2,645/residence,$295/renter,$3,845/commercial. Est. cost for additional 100 residential properties, $264,500 (100x$2,645). Total est. cost $1,328,340 ($1,063,840+$264,500)
	e. Task 5 - Relocation	$0					
	f. Task 6 - Follow Up	$0					
	g. Task 7 - Appeals	$0					
	h. Task 8 - Reporting	$0					
	i. Task 9 - Project Management and Closeout	$132,000					Current buyout is approximately $66,000/year (x 2 years)
	j. Contingencies	$500,000					Current state buyout hold back
	Subtotal LICRA Administration (Indirect) Costs	**$1,960,340**					
3.	**Total Capital Costs (2006 dollars)**	**$42,058,094**					Equal to Direct Capital Costs + URA Administration Costs; costs are already present values
4.	**Annual Operation and Maintenance Costs**						
	a. Administer institutional controls	1	lump sum	$0	$0		LICRA does include O&M.
	b. Vegetation management	1	lump sum	$0	$0		LICRA does include O&M.
	Subtotal Annual O&M Costs	**$0**					
	Net Present Value of Direct and LICDA Admin. Costs	**$42,058,094**					
	Total Net Present Value	**$42,058,094**					

Assume 100 residential properties (about 50% of the 211), not eligible for state buyout and remain in the area, to be relocated by EPA

Ref: October 3, 2007 e-mail from J. D. strong, Office of the secretary of the Environment

Remedial Component
Phase 1 Activities (Years 3 to 17)

Item #	Item Description	Est. Quantity	Units	Est. Unit Cost	Estimated Cost	Cost Basis	Assumptions
1.	**Chat Pile and Base Removal from the NE Distal Zone by Excavation and Hauling**						100% of material located in this area is removed by excavation and hauling; material delivered to chat washing operator located in central portion of the Site.
	a. Clear, grub, and remove old structures	559	acres	$533.50	$298,227	OCC-1	Entire area of piles and bases plus 50-foot buffer zone area. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Excavate and load chat	2,391,000	cu.yds.	$1.70	$4,064,700	CCI	See detail sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	2,391,000	cu.yds.	$3.11	$7,436,010	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and buffer zone	559	acres	$911.00	$509,249	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Amend soils prior to revegetation	559	acres	$320.00	$178,880	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate excavated areas	559	acres	$1,200.00	$670,800	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 1	**$13,157,866**					
2.	**Chat Pile and Base Removal from the SE Distal Zone by Excavation and Hauling**						100% of material located in this area is removed by excavation and hauling; material delivered to chat washing operator located in central portion of the Site.
	a. Clear, grub, and remove old structures	172	acres	$533.50	$91,762	OCC-1	Entire area of piles and bases plus 50-foot buffer zone area. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Excavate and load chat	630,000	cu.yds.	$1.70	$1,071,000	CCI	See detail sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	630,000	cu.yds.	$3.11	$1,959,300	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and buffer zone	172	acres	$911.00	$156,692	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Amend soils prior to revegetation	172	acres	$320.00	$55,040	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate excavated/deep tilled area	172	acres	$1,200.00	$206,400	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 2	**$3,540,194**					
3	**Chat Pile and Base Removal from the Elm Creek Watershed Distal Zone by Excavation and Hauling**						100% of material located in this area is removed by excavation and hauling; material delivered to chat washing operator located in central portion of the Site.
	a. Clear, grub, and remove old structures	381	acres	$533.50	$203,264	OCC-1	Entire area of piles and bases plus 50-foot buffer zone area. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Excavate and load chat	3,138,000	cu.yds.	$1.70	$5,334,600	CCI	See detail sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	3,138,000	cu.yds.	$3.11	$9,759,180	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and buffer zone	381	acres	$911.00	$347,091	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Amend soils prior to revegetation	381	acres	$320.00	$121,920	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate excavated/deep tilled area	381	acres	$1,200.00	$457,200	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 3	**$16,223,255**					
4.	**Excavate, Haul and Dispose of Smelter Wastes in a Local Repository**						
	a. Clear, grub, and remove old structures	14	acres	$533.00	$7,462	OCC-1	Includes brush and tree removal around source material area and affected soils area. Does not include removal of buildings or reinforced structures.
	b. Excavate and load smelter waste	1,846	cu.yds.	$1.70	$3,138	CCI	Shallow excavation, approximately 1 feet deep. See details sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	1,846	cu.yds.	$3.11	$5,741	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and smelter affected soils	14	acres	$911.00	$12,754	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Add biosolids or organic matter	280	tons	$30.00	$8,400	Jasper	20 tons per acre.
	f. Amend soils prior to revegetation	14	acres	$320.00	$4,480	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	g. Revegetate excavated/deep tilled area	14	acres	$1,200.00	$16,800	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 4	**$58,775**					
5.	**Inject Fine Tailings into Mine Workings**						Assumes 61 ponds containing an estimated 5,041,000 yd^3 of material (includes 10% of washed fines generated by processing) covering an estimated area of 569 acres is injected.

a. Clear and grub fine tailings and buffer zone areas	831	acres	$533.00	$442,923	OCC-1	Entire area of ponds addressed by injection plus 50-foot buffer zone area. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
b. Mobilize/move between ponds and injection locations	287	location	$13,012.00	$3,734,444	CCI	Assumes one move per injection boring (i.e., location) plus one mobilization.
c. Injection boring installation	286	boring	$16,000.00	$4,582,727	Venture Drilling	One 10-inch diameter injection boring per 17,600 yd3 of fine tailings material.
d. Extraction boring installation	61	boring	$16,000.00	$976,000	Venture Drilling	One 10-inch diameter extraction boring per pond.
e. Boring abandonment	347	boring	$10,000.00	$3,474,205	Venture Drilling	Bladder installation and cement grout to surface.
f. Inject fines at 200 tons/hour	5,041,000	cu.yds.	$5.76	$29,036,160	CCI	See detail sheets for unit rate development.
g. Deep till underlying soils and buffer zone	831	acres	$911.00	$757,041	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
h. Amend soils prior to revegetation	831	acres	$320.00	$265,920	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
i. Revegetate underlying soils/deep tilled areas	831	acres	$1,200.00	$997,200	CCI	Land area is disced, seeded and mulched.
Subtotal Item 5	**$44,266,620**					
6. Complete Hydrogeologic Studies						
a. Hydrogeologic investigations and studies	1	lump sum	$3,000,000.00	$3,000,000	Quapaw Tribe	Studies are completed to assess hydrogeologic system and potential impacts resulting from injection of source materials.
Subtotal Item 6	**$3,000,000**					
7. Cover Fine Tailings in Place with Soil Cover						
a. Clear and grub fine tailings and buffer zone areas	275	acres	$533.00	$146,575	OCC-1	Entire area of ponds addressed by covering plus 50-foot buffer zone area. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
b. Regrade and recontour tailings and berms	251	acres	$2,400.00	$602,400	CCI	No change in surface area.
c. Furnish and load cover soil	898,000	cu.yds.	$10.24	$9,195,520	CCI	Soil cover equivalent to 12-inches clay and 12-inches loam. See detail sheets for unit rate development.
d. Haul and dump cover soil(14.2 miles round trip)	898,000	cu.yds.	$3.41	$3,062,180	CCI	See detail sheets for unit rate development.
e. Compact cover soil	898,000	cu.yds.	$1.26	$1,131,480	CCI	See detail sheets for unit rate development.
f. Deep till buffer zone	24	acres	$911.00	$21,864	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
g. Amend soils prior to revegetation	275	acres	$320.00	$88,000	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
h. Establish cover vegetation/revegetate deep tilled area	275	acres	$1,200.00	$330,000	CCI	Land area is disced, seeded and mulched.
i. Institutional control - deed notice	28	parcel	$500.00	$13,750	Eng. Estimate	Assumes 1 parcel (i.e. deed notice) per 10 acres.
Subtotal Item 7	**$14,591,769**					
8. Integrate Near Stream Source Materials and Control Seepage/Runoff						Interim actions that may be required to prevent further damages to resources while chat processing (by others) is ongoing or before full-scale remedial actions can take place.
a. Clear and grub floodway areas	581	acres	$533.50	$309,964	CCI	Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
b. Integrate floodway chat with original source	1,252,952	cu.yds.	$2.26	$2,831,672	CCI	Assumes near-stream chat within 200 feet of streams requires integration with primary source. Assumes dozer work with no loading or hauling.
c. Integrate floodway fine tailings with original source	283,095	cu.yds.	$2.26	$639,795	CCI	Assumes near-stream tailings within 200 feet of streams require consolidation outside the floodway. Assumes dozer work with no loading or hauling.
d. Furnish and install rip-rap or revetment	4,228	cu.yds.	$39.11	$165,357	CCI	Assumes 48" of rip-rap placed at bends in stream channels where chat or tailings are located. Quantity based on 0.44tons/L.F. of stream length(3.2 miles). Rip rap from Midwest Mineral, Quapaw Quarry At $13.50/ton loaded plus 5.85% sales tax
e. Install berms and dikes - small berms	71,770	cu.yds.	$14.91	$1,070,091	CCI	Assume 2.67 CY of compacted clay per lineal foot of berm. Estimated using D-4 and CAT
f. Install sheet piling to prevent seepage and direct runoff	90,414	square feet	$25.00	$2,260,350	CCI	Assumes estimated linear distance of 5,023 feet, 18-foot sheet length.
g. Deep till excavated areas	581	acres	$911.00	$529,291	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
h. Amend soils prior to vegetation	581	acres	$320.00	$185,920	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
i. Revegetate excavated areas	581	acres	$1,200.00	$697,200	CCI	Land area is disced, seeded and mulched.
Subtotal Item 8	**$8,689,639**					
9. Excavation of In-Stream Source Materials from Tar, Lytle, and Beaver Creeks						Assumes sections of Tar Creek, Lytle Creek, Elm Creek, and Beavers Creek require source removal from stream beds and immediate banks.
a. Clear and grub stream banks	35	acres	$1,800.00	$63,000	CCI	

	b. Excavate source materials from streams	18,394	cu.yds.	$17.51	$322,079	CCI	Assumes near-stream chat within 200 feet of streams requires integration with primary source using a D-8. Assumes a Cat 330 hoe to pull additional material out of the streams and D-8 to integrate it with its primary source.
	c. Bank work and regrading	49,021	cu.yds.	$2.26	$110,787	CCI	Estimated using D-4
	d. Furnish and install rip-rap or revetment	3,595	cu.yds.	$39.11	$140,600	CCI	Assumes 48" of rip-rap placed at bends in stream channels where chat or tailings are located. Quantity based on 0.44tons/L.F. of stream length (2.7 miles). Rip rap from Midwest Mineral, Quapaw Quarry At $13.50/ton loaded plus 5.85% sales tax
	e. Amend bank soils prior to revegetation	35	acres	$320.00	$11,200	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate stream bank	35	acres	$1,200.00	$42,000	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 9	**$689,667**					
10.	**Covering of In-Stream Source Materials from Tar, Lytle, and Beaver Creeks Using a Flexible Membrane Liner**						Assumes sections of Tar Creek, Lytle Creek, Elm Creek, and Beavers Creek require installation of FML, approximately 6.5 miles of streams, combined, 60 feet wide.
	a. Stream liner (60-mil HDPE)	2,059,200	square feet	$2.21	$4,550,832	CCI	60 mil HDPE liner 36 feet wide installed in 10.8 miles of stream. 30' wide under stream with 3' buried as anchors on each side
	b. Filter blanket (fines)	152,533	cu.yds.	$14.33	$2,185,803	CCI	The 152,533 cy is 10.8 miles @ 2' thick and 36' wide. The material will be purchased from a local quarry, hauled, dumped, spread, and compacted. Price at the quarry is $3.95/ton loaded plus 5.85% sales tax.
	c. Bank work and regrading, ground prep	305,067	cu.yds.	$2.26	$689,451	CCI	Estimated using D-4
	d. Furnish and install rip-rap	152,533	cu.yds.	$39.11	$5,965,579	CCI	Assumes 48" of rip-rap placed at bends in stream channels where chat or tailings are located. Quantity based on 0.44tons/L.F. of stream length. Rip rap from Midwest Mineral, Quapaw Quarry at $13.50/ton loaded plus 5.85% sales tax.
	e. Amend bank soils prior to vegetation	35	acres	$320.00	$11,200	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate stream bank	35	acres	$1,200.00	$42,000	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 10	**$13,444,864**					
11.	**Provide Alternative Water Supply for Impacted Rural Residential Wells**						
	a. Connect affected households to supplied water system	2	households	$15,000.00	$30,000	Best estimate	Alternative supplied water system is within economically feasible distance to complete connection.
	Subtotal Item 11	**$30,000**					
12.	**Excavate Rural Residential Yard Soils**						
	a. Excavate, backfill, and restore residential yard soils	5	households	$28,000.00	$140,000	EPA-2005	Average cost of OU-2 yards completed in 2005.
	Subtotal Item 12	**$140,000**					

13.	**Construction and Closure of On-Site Repository**						Construction of a 28-acre repository capable of receiving an estimated 998,000 yd ^{3} of source materials and associated debris.
	a. Property acquisition including surrounding buffer area	56	acres	$1,000.00	$56,000	Eng. Estimate	28 acre repository with surrounding 200-foot buffer zone equivalent to 28 additional acres.
	b. Clear and grub	28	acres	$533.00	$14,924	OCC-1	Entire area of proposed repository. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	c. Grading and site work	28	acres	$2,400.00	$67,200	CCI	Upper 6-inches removed and stored.
	d. Furnish and load clay liner soil	90,000	cu.yds.	$10.24	$921,600	CCI	Liner equivalent to 24-inches clay. See detail sheets for unit rate development.
	e. Haul and dump clay liner soil(14.2 miles round trip)	90,000	cu.yds.	$3.41	$306,900	CCI	See detail sheets for unit rate development.
	f. Compact clay liner soil	90,000	cu.yds.	$1.26	$113,400	CCI	See detail sheets for unit rate development.
	g. Furnish, load, and install filter sand	90,000	cu.yds.	$5.00	$450,000	Quapaw Tribe	2-feet thick filter sand layer using drag sands available at no cost.
	h. Furnish and load cover soils	90,000	cu.yds.	$10.24	$921,600	CCI	Soil cover equivalent to 12-inches clay and 12-inches loam. See detail sheets for unit rate development.
	i. Haul and dump cover soils(14.2 miles round trip)	90,000	cu.yds.	$3.41	$306,900	CCI	See detail sheets for unit rate development.
	j. Compact cover soils	90,000	cu.yds.	$1.26	$113,400	CCI	See detail sheets for unit rate development.
	k. Amend soils prior to vegetation	28	acres	$320.00	$8,960	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	l. Revegetate excavated areas	28	acres	$1,200.00	$33,600	CCI	Land area is disced, seeded and mulched.
	m. Institutional control - deed notice	1	parcel	$1,000.00	$1,000	Eng. Estimate	Assumes 1 parcel (i.e. deed notice) for entire 28-acre repository.
	Subtotal Item 13	**$3,315,484**					
	Total Phase 1 Direct Capital Costs	**$121,148,131**					

Phase 2 Activities (Years 26 to 30)

14.	**Address Non-Processed Chat from Piles, Bases, and Rail Road and Road Beds**						Assumes 76% of all chat has been processed by others (not part of the remedy), with 9,380,000 yd^3 remaining to be addressed by the remedy.
14.1	**Excavate and Haul to Local Washing Operation**						Assumes 85% (7,973,000 yd^3) of non-processed chat is delivered to an on-site chat washing operation.
	a. Clear, grub, and remove old structures	2,892	acres	$533.50	$1,542,882	OCC-1	85% of all entire acreage covered by piles and bases including 50-foot buffer zone area but excluding the area already addressed by Distal Area remedy. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Excavate and load chat	7,973,000	cu.yds.	$1.70	$13,554,100	CCI	See detail sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	7,973,000	cu.yds.	$3.11	$24,796,030	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and buffer zone	2,892	acres	$911.00	$2,634,612	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Amend soils prior to revegetation	2,892	acres	$320.00	$925,440	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate excavated areas	2,892	acres	$1,200.00	$3,470,400	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 14.1	**$46,923,464**					
14.2	**Excavate and Haul to an On-Site Repository**						Assumes 10% (938,000 yd^3) of non-processed chat is delivered to an on-site repository.
	a. Clear, grub, and remove old structures	340	acres	$533.50	$181,390	OCC-1	10% of all entire acreage covered by piles and bases including 50-foot buffer zone area but excluding the area already addressed by Distal Area remedy. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Excavate and load chat	938,000	cu.yds.	$1.70	$1,594,600	CCI	See detail sheets for unit rate development.
	c. Haul, dump and place, 12-mile roundtrip	938,000	cu.yds.	$3.11	$2,917,180	CCI	See detail sheets for unit rate development.
	d. Deep till excavated area and buffer zone	340	acres	$911.00	$309,740	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	e. Amend soils prior to revegetation	340	acres	$320.00	$108,800	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	f. Revegetate excavated areas	340	acres	$1,200.00	$408,000	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 14.2	**$5,519,710**					

14.3.	**Inject Chat into Mine Workings**						Assumes 5% (469,000 yd^3) of non-processed chat is injected into flooded underground mine workings.
	a. Clear, grub, and remove old structures	170	acres	$533.00	$90,610	OCC-1	5% of all entire acreage covered by piles and bases including 50-foot buffer zone area but excluding the area already addressed by Distal Area remedy. Does not include removal of buildings or reinforced structures (i.e., mill foundations, etc.).
	b. Mobilize/move between piles/bases and injection locations	95	location	$16,193.00	$1,535,096	CCI	Moves equivalent to one mobilization and movement between injection sites based upon an average injection of 5,000 yd^3 per boring.
	c. Injection boring installation	94	boring	$16,000.00	$1,500,800	Venture Drilling	One 10-inch diameter injection boring per 5,000 yd^3 of chat material.
	d. Extraction boring installation	19	boring	$16,000.00	$300,160	Venture Drilling	One 10-inch diameter extraction boring per every 5 injection borings (20-percent).
	e. Boring abandonment	113	boring	$10,000.00	$1,125,600	Venture Drilling	Bladder installation and cement grout to surface.
	f. Inject chat at 100 tons/hour	469,000	cu. yds.	$8.91	$4,178,790	CCI	See detail sheets for unit rate development.
	g. Deep till underlying soils and buffer zone	170	acres	$911.00	$154,870	CCI	Two D-8 Dozers, one making one pass with a 16' wide mouldboard gang plow and the other, two passes of a 30" disc harrow and spring tooth harrow pulled in tandem. 3 MPH average speed used. The appropriate number of moves is included in the unit cost.
	h. Amend soils prior to revegetation	170	acres	$320.00	$54,400	CCI	2 tons lime and 100 pounds each of nitrogen and phosphorous fertilizer per acre.
	i. Revegetate underlying soils/deep tilled areas	170	acres	$1,200.00	$204,000	CCI	Land area is disced, seeded and mulched.
	Subtotal Item 14.3	**$9,144,326**					
	Total Phase 2 Direct Capital Costs	**$61,587,500**					
	Total Direct Capital Costs (Phase 1 + Phase 2)	**$182,735,632**					
15.	**Indirect Capital Costs**						
	a. Develop and implement institutional controls program	1	lump sum	$500,000	$500,000	Best estimate	
	b Project management	1	lump sum	$9,136,782	$9,136,782	EPA, 2000	Assume 5% of total direct capital cost
	c. Remedial design	1	lump sum	$9,136,782	$9,136,782	EPA, 2000	Assume 5% of total direct capital cost
	d. Construction oversight and management	1	lump sum	$10,964,138	$10,964,138	EPA, 2000	Assume 6% of total direct capital cost
	e. Technical support	1	lump sum	$3,654,713	$3,654,713	EPA, 2000	Assume 2% of total direct capital cost; assumes performance of monitoring (i.e., air, groundwater, surface water,) during implementation of the remedy and confirmation sampling.
	f. Contingencies	1	lump sum	$36,547,126	$36,547,126	EPA, 2000	Assume 20% of total direct capital cost; 15% scope, 5% bid.
	g. Chat sales compliance, environmental monitoring, and oversight	1	lump sum	$37,701,800	$37,701,800	EPA, 2007	Refer to Appendix E
	Subtotal Indirect Capital Costs	**$107,641,340**					
16.	**Total Capital Costs**	**$290,376,972**					
17.	**Annual Operation and Maintenance Costs**						
	a. Administer landowner agreements	1	lump sum	$100,000.00	$100,000	Best estimate	Assume 1 FTE plus expenses
	b. Administer institutional controls	1	lump sum	$25,000.00	$25,000	Best estimate	Assume 1/4 FTE in the Ottawa County clerk's office plus expenses.
	c. Vegetation management	1	lump sum	$250,000.00	$250,000	Best estimate	Assumes management of revegetated areas for 3 years after initial seeding. Goes to zero after 20 years.
	Subtotal Annual O&M Costs	**$375,000**					

18.

Net Present Value Cost Analysis	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Direct Capital Costs			$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542
Indirect Capital Costs	$1,508,072	$1,508,072	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049
Operation and Maintenance Costs			$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000
Total Capital and O&M Costs	$1,508,072	$1,508,072	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591
Net Present Value	$1,409,413	$1,317,208	$10,984,587	$10,265,969	$9,594,363	$8,966,695	$8,380,089	$7,831,858	$7,319,494	$6,840,649
Year	1	2	3	4	5	6	7	8	9	10

Net Present Value Cost Analysis	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Direct Capital Costs	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542	$8,076,542			
Indirect Capital Costs	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$5,005,049	$1,508,072	$1,508,072	$1,508,072
Operation and Maintenance Costs	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000	$375,000
Total Capital and O&M Costs	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$13,456,591	$1,883,072	$1,883,072	$1,883,072
Net Present Value	$6,393,129	$5,974,887	$5,584,007	$5,218,698	$4,877,288	$4,558,213	$4,260,012	$557,133	$520,685	$486,622
Year	11	12	13	14	15	16	17	18	19	20

Net Present Value Cost Analysis	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Totals
Direct Capital Costs						$12,317,500	$12,317,500	$12,317,500	$12,317,500	$12,317,500	$182,735,630
Indirect Capital Costs	$1,508,072	$1,508,072	$1,508,072	$1,508,072	$1,508,072	$3,496,977	$3,496,977	$3,496,977	$3,496,977	$3,496,977	$107,641,340
Operation and Maintenance Costs	$375,000	$375,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$8,500,000
Total Capital and O&M Costs	$1,883,072	$1,883,072	$1,633,072	$1,633,072	$1,633,072	$15,939,477	$15,939,477	$15,939,477	$15,939,477	$15,939,477	$298,876,970
Net Present Value	$454,787	$425,034	$344,491	$321,955	$300,892	$2,744,706	$2,565,146	$2,397,333	$2,240,498	$2,093,923	$125,229,763
Year	21	22	23	24	25	26	27	28	29	30	

19.

Total Net Present Value for Phase 1 and 2	**$125,229,763**
Total Net Present Value for Voluntary Relocation	**$42,058,094**
Total Net Present Value for Alternative 5	**$167,287,857**

Notes and Assumptions:

Phase 1 Direct Capital Costs are spread evenly over 15 years in the Net Present Value calculation (years 3 - 17).
Phase 2 Direct Capital Costs are spread evenly over years 26 through 30 in the Net Present Value calculation.
Assume indirect capital costs are spread evenly over the 20-year construction timeframe in years 3 to 17 and 26 to 30, with the exception of item"g' which is spread evenly over the first 25 years.
Assume O&M costs, $375,000/year, start in year 3 and continue for 20 years, then drop to $125,000 per year.
The Net Present Value analysis assumes 30 years of O&M at a discount rate of 7 percent.

Table 12
Final Cleanup Levels for Chemicals of Concern

Media: Source Material/Soil
Site Area: Sitewide
Available Use: Future Residential
Controls to Ensure Restricted Use: Institutional Controls for Containment Area Only

Chemicals of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Cadmium	10 mg/kg (see Note 2)	Ecological Risk Assessment	LOAEL for Vermivores (see Note 3)
Lead	500 mg/kg (see Note 1)	Human Health Risk Assessment	< 5% of Children and Adolescents Exceeding 10 ug/dL Blood-lead Level
Zinc	1100 mg/kg (see Note 2)	Ecological Risk Assessment	LOAEL for Vermivores (see Note 3)

Notes

1. Verification of the cleanup level for lead should be conducted by analyzing the portion of the material that passes through a #60 mesh sieve.
2. Verification of the cleanup level for cadmium and zinc should be conducted by analyzing the bulk material without sieving.
3. The corresponding human health risk is an HI of .25 for Cadmium, and an HI of .05 for Zinc.

Media: Groundwater
Site Area: Site Water Tap
Available Use: Future Residential
Controls to Ensure Restricted Use: N/A

Chemicals of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Lead	.015 mg/L	National Primary Drinking Water Standard for Lead – Treatment Technology Based	Cleanup level is treatment technology based

Notes

1. See Table 13 (Final ARARs for the Selected Remedy) for discussion of the requirements for lead in drinking water.

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
Federal Regulatory Requirement	Ground Water	Federal Safe Drinking Water Act National Primary Drinking Water Regulations Subpart I 40 CFR Part 141.8	Relevant and Appropriate	The requirements of subpart I constitute the national primary drinking water regulations for lead. The provisions of this subpart apply to community water systems and non-transient, non-community water systems.	The selected remedy will comply with these regulations by providing an alternative water supply for rural residences where mining-related contaminants in water drawn from wells exceed .015 mg/L for lead.
Federal Regulatory Requirement	Air	Clean Air Act National Primary and Secondary Ambient Air Quality Standards 40 CFR Part 50.6 (PM_{10}) and Part 50.12 (Lead)	Relevant and Appropriate	PM_{10} The level of the national primary and secondary 24-hour ambient air quality standards for particulate matter is 150 micrograms per cubic meter ($\mu g/m^3$), 24-hour average concentration. Lead National primary and secondary ambient air quality standards for lead and its compounds, measured as elemental lead are: 1.5 micrograms per cubic meter, maximum arithmetic mean averaged over a calendar quarter.	Best Management Practices will be implemented for the response actions to prevent the emissions of lead and particulates. Periodic air monitoring will be conducted to ensure that the BMPs are meeting the standands.
Federal Regulatory Requirement	Surface Water	Clean Water Act National Pollutant Discharge Elimination System 40 CFR Part 122.26 Stormwater Discharges	Relevant and Appropriate	These rules were established specifically for discharges of waters composed entirely of storm water from industrial facilities, including most mining facilities, that are not already the subject of an NPDES permit. The Federal Storm	Implementation of all response actions will include PPPs developed during the remedial design stage and the implementation of BMPs will be required throughout the implementation of the

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
				Water regulations include requirements for obtaining storm water permits, implementing best management practices (BMPs) and developing pollution prevention plans (PPPs) at industrial facilities and construction sites. Industrial activity includes active and inactive mining areas.	remedy.
Federal Regulatory Requirement	NA	National Historic Preservation Act 16 USC Sec. 470 40 CFR Part 6.301(b)	Relevant and Appropriate	Requires Federal agencies to take into account the effect of any Federally assisted undertaking of licensing on any district, site, building, structure, or object that is included in or eligible for Register of Historic Places	A review was conducted during the RI/FS by the COE to identify locations that would be eligible for the Register of Historic Places. Implementation of the remedy will be carried out in such a way to minimize any impact on the identified locations.
Federal Regulatory Requirement	Surface Water, Ground Water, Soil, Source Material	Endangered Species Act 16 USC Secs. 1531-1544 40 CFR Part 6.302(h)	Relevant and Appropriate	Requires Federal agencies to identify effects of any Federal actions where Threatened or Endangered Species or Critical habitat may occur.	The implementation of the remedy will be designed to minimize any impact on critical habitats identified by USFWS for the Ozark cavefish. Based on available information, the Ozark cavefish is not found within the Site, however, as part of this ROD, EPA will conduct a hydrogeological study that could be used to evaluate specific locations where habitat may exist outside the boundaries of the site.

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
Federal Regulatory Requirement	Ground Water	Safe Drinking Water Act 40 CFR Part 144 Underground Injection Control Program	Applicable for Indian lands Relevant and Appropriate for non-Indian lands	The Underground Injection Control (UIC) program defines the performance standards for injection activities. The UIC regulations classify the type of injection in the ROD as a Class V injection well because it constitutes a mine backfill well used to inject mill tailings into mined out portions of the subsurface. Specific requirements include a prohibition of the movement of fluid containing any contaminant into a underground source of drinking water, if the presence of that contaminant causes a violation of the primary drinking water standards under 40 CFR part 141, other health based standards, or may otherwise adversely affect the health of persons. 40 CFR part 141 applies to public water systems. Wells must be closed in a manner that complies with the above prohibition of fluid movement.	The remedy includes the implementation of a site-wide hydrogeologic study to evaluate the potential impacts from the injection of source materials into the mine workings. The results of this study will be used to gauge the impacts to underground sources of drinking water.
State Regulatory Requirement	Groundwater	Oklahoma Solid Waste Management Act, 27A O.S. § 2-6-701 et seq.	Applicable for non-Indian lands	The State UIC requires groundwater monitoring, analysis of injected fluids and a description of the geologic	The remedy includes the implementation of a site-wide hydrogeologic study to evaluate the potential

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
		Management of Solid Waste Title 252 OAC, Chapter 652 Underground Injection Control		strata and any additional information required to demonstrate compliance with the federal requirements in 40 CFR 144.12.	impacts from the injection of source materials into the mine workings. The results of this study will be used to gauge the impacts to underground sources of drinking water.
Federal Regulatory Requirement	Surface Water	Clean Water Act §404 33 CFR parts 320-330 and 40 CFR part 230	Relevant and Appropriate	Regulates the discharge of dredged or fill materials into waters of the U.S. Discharges of dredged or fill materials are not permitted unless there is no practicable alternative that would have less adverse impact on the aquatic ecosystem. Any proposed discharge must avoid, to the fullest extent practicable, adverse effects, especially on aquatic ecosystems. Unavoidable impacts must be minimized, and impacts that cannot be minimized must be mitigated.	As part of the selected remedy under this ROD, a watershed-based approach will be taken to address the potential effects remedial actions may have on the local watersheds. A baseline hydrology model will be developed as part of the remedial design to reflect the existing land uses in the basin. The model may also be used as a planning and design tool to prepare a comprehensive watershed plan.
State Regulatory Requirement	Ground Water	Oklahoma Water Quality Standards OAC 785:45 Appendix H Beneficial Use Designations for Certain Limited Areas of Groundwater	Applicable	The Oklahoma Water Resources Board (OWRB) regulations place restrictions on any new well construction in the Boone formation.	Monitor wells installed during the response action will be designed to comply with special well construction standards. ODEQ will also ensure that new water wells installed at the Site meet the special well construction standards.
State Regulatory Requirement	Soil	Oklahoma Statutes 27A § 2-7-123(B)	Applicable	The ODEQ shall file a recordable notice of remediation or related action taken pursuant to the federal	ODEQ will file the deed notice upon completion of construction at each individual property requiring

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
				Comprehensive Environmental Response, Compensation and Liability Act in the land records of the county in which the site is located. The notice shall contain a legal description of the affected property and shall identify all engineering controls used to ensure the effectiveness of the remediation. The notices shall also contain a prohibition against engaging in any activities that cause or could cause damage to the remediation or the engineering controls, or recontamination of the soil or groundwater. The notices shall also contain any appropriate restrictions on land use or other activities that are incompatible with the cleanup level, including, but not limited to, restrictions against using groundwater for drinking or irrigation purposes or redeveloping the land for residential use.	engineering controls.
State Regulatory Requirement	Soil/Source Material	Oklahoma Solid Waste Management Act, 27A O.S. § 2-10-101 et seq. Management of Solid Waste Title 252 OAC, Chapter 515	Applicable	The Oklahoma statute and rules establish requirements for construction of non-hazardous waste landfills. The definition of non-hazardous industrial waste includes the types of mining waste found at the Tar Creek site.	The design and construction of the repositories in the remedy will comply with the requirements established in Chapter 515. Any alternative design will require the approval of EPA. The cover for the fine

Table 13: Final ARARs for Selected Remedy					
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
					tailings ponds will comply with Chapter 515-19-53 which establishes the design standards for a final cover. Any alternative design will require the approval of EPA.

Table 14: Matrix of Cost and Effectiveness Data

Relevant Considerations for Cost-Effectiveness Determination:

- Volume of Source Material is estimated at 50 million cubic yards
- Risk due to exposure of lead in Source Material predicts 22.3% of adolescents would have blood-lead levels exceeding 10ug/dL.

Alternative (check box if cost effective)	**Present Worth Cost**	**Incremental Cost Compared to Preceding Alternative**	**Long-Term Effectiveness and Permanence**	**Reduction of TMV Through Treatment**	**Short-term Effectiveness**
1) No Action ☐	$0	----	• No reduction in long-term risk to human health and the environment • 4220 acres of land with Source Material	Not applicable	• No short-term protection for the community.
4) Phased Consolidation and On-Site Disposal ☑	$167,735,000	+$167,735,000	↑ Achieves RAOs for all Source Material areas ↑ 322 acres subject to ICs for long-term control	Not applicable	↑ Majority of residents not protected until 20th yr.
5) Voluntary Relocation, Phased Consolidation and On-Site Disposal ☑	$167,288,000	-$447,000	↔ Achieves RAOs for all Source Material areas ↔ 322 acres subject to ICs for long-term control	Not applicable	↑ Majority of residents protected following relocation in 3 years.
8) Total Source Consolidation and On-Site Disposal ☐	$255,909,000	+$88,621,000	↔ Achieves RAOs for all Source Material areas ↓ 846 acres subject to ICs for long-term control	Not applicable	↓ Majority of residents not protected until 20th yr.

COST-EFFECTIVENESS SUMMARY: (Summary of individual cost-effectiveness evaluations and relative cost-effectiveness determinations)

- Alternatives 1 and 8 are not considered to be cost-effective
- While Alternative 4 and 5 are considered to be cost-effective, Alternative 5 provides a potentially greater return on investment.

Key: ● **=** Baseline characteristic ↓ = less "effective" than preceding alternative
↑ = More "effective" than preceding alternative ↔= No change compared to preceding alternative