



PREASSESSMENT SCREEN AND DETERMINATION
Newton County Mine Tailings Superfund Site
Newton County, Missouri
by
Missouri Department of Natural Resources
U.S. Department of the Interior

This is the Preassessment Screen for the Newton County Mine Tailings Superfund Site, located in Newton County, Missouri. This document has been prepared by the Missouri Department of Natural Resources (MDNR) and the U.S. Department of the Interior (DOI) who are Trustees for natural resources at the Newton County Mine Tailings Superfund Site (individually and collectively referred to hereinafter as "Trustees").

AUTHORITY

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, 42 U.S.C. 9601 et seq., the Oil Pollution Act of 1990 (OPA), 33 U.S.C. 2701 et seq., and the Federal Water Pollution Control Act (FWPCA), as amended, 33 U.S.C. 1251 et seq., authorize the United States, States and Indian tribes to recover damages for injuries to natural resources and their supporting ecosystems, belonging to, managed by, appertaining to, or otherwise controlled by them.

In accordance with 42 U.S.C. 9607(f)(2)(B) and the National Contingency Plan, 40 CFR § 300.600 (NCP), the Director of MDNR has been designated the natural resource trustee by the Governor of Missouri. MDNR acts on behalf of the public as Trustee for natural resources, including their supporting ecosystems, within the boundary of Missouri or belonging to, managed by, appertaining to, or otherwise controlled by Missouri.

Through Executive Orders and the NCP, the President has designated the Secretary of the DOI to act on behalf of the public as Trustee for natural resources and their supporting ecosystems, managed or otherwise controlled by the DOI. The official authorized to act on behalf of the Secretary at the Newton County Mine Tailings Superfund Site is the Regional Director for Region 2 of the U.S. Fish and Wildlife Service. Executive Order 12580, dated January 23, 1987; and 40 C.F.R. § 300.600.

PURPOSE

The purpose of this Preassessment Screen is to provide a review of readily available information on discharges or releases of hazardous substances and the potential resulting impacts on natural resources at the Newton County Mine Tailings Superfund Site, Newton County, Missouri for which the DOI or MDNR may assert trusteeship under section 107(f) of CERCLA.

Federal Regulations at 43 CFR § 11.23(a) provide for the Trustees to complete a Preassessment Screen and make a determination as to whether there is a reasonable probability of making a successful claim for natural resource damages before assessment efforts are undertaken. This document fulfills that requirement and follows the structure of Federal Regulations at 43 CFR Part 11. These regulations provide a method for the assessment of natural resource damages resulting from releases of hazardous substances under CERCLA. Adherence to the methods set forth in these regulations is not mandatory and does not preclude the Trustees' use of alternate methods of assessing damages or arriving at a negotiated settlement with potentially responsible parties.

SITE INFORMATION

The Newton County Mine Tailings Superfund Site is located within the Tri-State Mining District which encompasses the western edge of the Ozark Uplift in Missouri, west and south through Kansas and Oklahoma to the eastern fringe of the Great Plains. The topography of Newton County Mine Tailings Superfund Site is largely one of low rolling hills and plateaus at elevations of approximately 1,000 feet above sea level. The principal drainage system for Newton County is Shoal Creek and its tributaries. Lost Creek and its tributaries comprise a second drainage system within Newton County. There are four separate, but adjacent Superfund sites within the Tri-State Mining District: the Newton County Mine Tailings Superfund Site, the Oronogo/Duenweg Mining Belt Superfund Site (aka Jasper County Site) both located in Missouri; the Cherokee County Superfund Site, Cherokee County, Kansas; and the Tar Creek Superfund Site, Ottawa County, Oklahoma.

This Preassessment Screen addresses only the Newton County Mine Tailings Superfund Site portion of the Tri-State Mining District and the various designated areas (DAs) that comprise the Newton County Mine Tailings Superfund Site. The Trustees recognize that there may be injuries to natural resources outside of the State of Missouri, resulting from releases within the Newton County Mine Tailings Superfund Site. This Preassessment Screen does not cover those injuries or damages outside of the State of Missouri that have or may result from releases or discharges from within the Newton County Mine Tailings Superfund Site. Injuries or damages outside of the State of Missouri that have or may result from releases or discharges from within the Newton County Mine Tailings Site may be addressed as part of separate actions at the Cherokee County and Tar Creek Sites. The Trustees are Partners of the Tri-State Mining District Natural Resource Restoration Inter-governmental Partnership. As such, the Trustees are communicating, coordinating, and cooperating with other Partners and Natural Resource Trustees throughout the Tri-State Mining District.

1) Time, quantity, duration and frequency of the discharge or release

Contaminants at the Newton County Mine Tailings Superfund Site are consistent with waste produced through the mining, milling and smelting processes that took place at this location starting in the mid-19th century. Mine production for lead and zinc peaked in

sources associated with the placement and disposal of mine wastes. Flooded mine shafts and underground mine workings have exposed mineralized areas, leading to the contamination of groundwater as it has come into contact with ore and subsurface wastes. Injured groundwater estimates at the Newton County Mine Tailings Superfund Site could exceed 680,000 acre-feet. Contaminated groundwater, in turn, serves as a surficial source as seeps. Surficial contamination includes terrestrial areas, surface water, and sediments. Other surficial sources of hazardous substances include chat piles, tailing sites, development and waste rock piles, subsidence ponds and contaminated soils and stream sediments.

Based on sampling conducted in 1995, 1998, and 2000, the Environmental Protection Agency (EPA) determined that at least 400 residential wells exceed the maximum contaminant level (MCL-health based action levels) for lead and cadmium above health based action levels of 15 parts per billion (ppb) and 5 ppb, respectively. Residential yard and drinking water well removal actions were performed by the EPA and the potentially responsible parties (PRPs) from 1998 – 2007. The MDNR has placed a restriction on drilling wells into the shallow aquifer on 48,800 acres or 76.25 square miles of Newton County due to the contamination caused by lead and zinc mining. The Newton County Mine Tailings Superfund Site was placed on the NPL on September 29, 2003, because of extensive groundwater contamination. The lead, zinc, and cadmium criterion of 15 parts per billion (ppb), 5,000 ppb, and 5 ppb, respectively, have been exceeded.

The EPA sampled sediment in 1995 and 2006. This sampling data indicates sediment is contaminated in Shoal Creek and its tributaries below the Granby DA as well as tributaries of Shoal Creek that drain the Spring City-Spurgeon DA. MacDonald et al (2000) identified Consensus-Based Sediment Quality Guidelines Threshold Effects Concentrations (TEC) and Probable Effects Concentrations (PEC). The TEC represents the level below which it is unlikely to observe a toxic effect to organisms. The PEC represents a sediment concentration above which it is likely to observe aquatic effects to aquatic organisms. Sediment samples in Shoal Creek have exceeded the MacDonald TEC and/or PEC for zinc and cadmium at the confluence of tributaries that drain the Granby DA. Maximum concentrations of cadmium (77 mg/kg) and zinc (25,000 mg/kg), which are 15 and 50 times the TEC, respectively, were found in Gum Spring Branch. The maximum concentration of lead (1100 mg/kg), which is approximately nine times the TEC, was found in Wolf Creek (U.S. EPA, 1995). Sampling conducted by EPA in 2006 indicates that upper Center Creek draining the Wentworth DA and Lost Creek below the Spring City-Spurgeon DA are contaminated above the PEC.

Approximately 804 acres within the Diamond, Granby, Spring City, Spurgeon, Stark City and Wentworth DAs are contaminated with chat, tailings, vegetated chat and transition zone soils. The number of impacted acres is based on a review of topographical maps and aerial photography. Transition zone soils, contaminated by runoff from tailings, chat and vegetated chat, represents a 200-foot buffer around the piles (Dames and Moore, 1995) and results in approximately an additional 120 contaminated acres at this site. The

The Jasper County Site Ecological Risk Assessment (ERA) established remedial soil concentrations for cadmium, lead, and zinc (41 mg/kg, 804 mg/kg, and 6424 mg/kg, respectively), based on a literature review. The review resulted in the establishment of the lowest observed adverse effect level (LOAEL) for worm-eating mammals and birds. The Trustees have identified alternative values that are based on the geometric mean of the LOAEL and the no observed adverse effect level (NOAEL) literature values and/or literature values found to be protective of soil function and plant growth for cadmium, lead, and zinc, which are 4.6 mg/kg, 670 mg/kg, and 720 mg/kg, respectively. Operations at the Newton County Mine Tailings Superfund Site have resulted in 804 acres of land that exceed these concentrations for one or more of these contaminants.

2) The hazardous substances released

Much of this waste is highly contaminated with hazardous substances, including cadmium (CAS # 7440439), lead (CAS # 7439921) and zinc (CAS # 7440666). These compounds or mixtures have been identified under CERCLA §101 (14) as hazardous substances (40 CFR §302, Table 302.4).

3) History of the current and past use of the Site

The current and past land uses in the county are un-impacted natural land, mining-related, urban, arable agriculture (mainly wheat, sorghum, corn, soybeans, and hay) as well as cattle grazing and numerous concentrated animal feeding operations. Lead and zinc mining began in Newton County in the mid-19th century and reached peak production around 1916. Diminishing production led to the closure of the mining industry in Newton County around 1950. While it has been estimated that a majority of the mine waste has been removed from the Newton County Mine Tailings Superfund Site to provide fill and to serve as aggregate for buildings and roads, hundreds of acres of wastes still remain on the surface (U.S. EPA, 1995).

4) Relevant operations occurring at or near the Site

Mining operations were principally underground and involved sinking shafts into subsurface ore bodies. In general, the raw ore was brought to the surface and crushed in stages with the metals being separated by gravity separation or flotation. Waste rock, development rock, chat, and tailings materials were usually dumped on the surface in waste piles or impoundments. Many wastes were re-milled as more efficient separation techniques became available. Initially there may have been crude log smelters associated with each mine. By the late 1800s, these smelters were consolidated, including a large one that operated in Granby, Newton County, MO.

5) Additional hazardous substances potentially released from the Site

Other hazardous substances potentially released from the Newton County Mine Tailings Superfund Site include copper (CAS # 7440-50-8), nickel (CAS # 7440-02-0), selenium (CAS # 7782-49-2) and acid mine drainage.

6) Potentially responsible parties

The Potentially Responsible Parties at this site include, but are not limited to, ASARCO, Inc.; Blue Tee Corporation; Paramount Communications (Viacom, Inc.), Eagle Picher, Inc., Eljer Plumbingware, Inc., Burlington Northern & Santa Fe Railway Company, Richards & Conover Steel Co., and Gold Field Corporation. Through agreements with EPA, Asarco and Blue Tee Corporation have participated in remedial activities at the site.

No Statutory Exclusions from Liability under CERCLA Apply at this Site

Injuries to natural resources and damages resulting from the discharge or release of the hazardous substances at the Newton County Tailings Superfund Site were not identified in any environmental impact statement, pursuant to the National Environmental Policy Act (NEPA), as amended (42 U.S.C. 4321 et seq.), or any similar review or document.

The release or discharge of the hazardous substances at the Newton County Mine Tailings Superfund Site are ongoing and did not occur wholly before enactment of CERCLA, nor the 1977 amendments to the FWPCA. Injuries to natural resources and damages to the public from the release or discharge of the hazardous substances are ongoing and did not occur wholly before enactment of CERCLA, nor the 1977 amendments to the FWPCA.

The hazardous substances at the Newton County Mine Tailings Superfund Site are not pesticide products registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended (7 U.S.C. 135-135k). Injuries to natural resources and damages resulting from the discharge or release of the hazardous substances at the Newton County Mine Tailings Superfund Site did not result from the application of a FIFRA registered pesticide product.

Injuries to natural resources and damages resulting from the discharge or release of the hazardous substances at the Newton County Mine Tailings Superfund Site did not result from any federally permitted release as defined in CERCLA §101 (10).

The hazardous substances are not recycled oil products as described in CERCLA §107(a)(3) or (4). Injuries to natural resources and damages resulting from the discharge or release of the hazardous substances at the Newton County Mine Tailings Superfund Site did not result from release of a recycled oil product.

No exclusion from damages is applicable to this site, pursuant to the CERCLA and FWPCA.

Preliminary identification of pathways

Surficial mine and mill wastes, soils, and groundwater all act as sources of hazardous

Mine Tailings Superfund Site. Hazardous substances can be released directly from these sources into the air, groundwater, surface water, and soils.

Smelters can release metals directly into the air, where they can potentially be moved and later deposited in another location. In addition, air can entrain metals as it flows over fugitive dust sources such as chat piles.

Rain water percolating through the mine waste piles can leach hazardous substances into the soil beneath the waste pile. Groundwater can also be affected as it flows through underground mine workings and comes into contact with exposed ore bodies.

Surface water can receive hazardous substances directly from erosion of various types of mine waste products during runoff. Stream sediment is habitat for a wide-variety of benthic invertebrates and fish. Contaminated sediment provides exposure through incidental ingestion and by increasing metal concentrations in the pore water of the sediment. Contaminated pore-water is a pathway through direct exposure through the gills of aquatic organisms. In addition, infiltration of water into waste piles can mobilize hazardous substances into solution, resulting in contaminated runoff to surface water.

Air, groundwater, surface water, and soils may receive hazardous substances not only directly from the sources, but also from each other. Air can transport hazardous substances and deposit them directly into surface water or onto soils. Hazardous substances can also move back and forth between ground and surface water through discharge and recharge.

Terrestrial and aquatic biota may be exposed to contaminants in environmental media either directly (for example, plants exposed directly to hazardous substances in soils) or indirectly through food chain transfer.

While an ERA has not been conducted for the Newton County Mine Tailings Superfund Site, the site is contiguous with the Jasper County Site where an ERA has been conducted. The contaminants found at the Newton County Mine Tailings Superfund Site are consistent with mining related contaminants that were and are being released through the mining, milling and smelting processes that have taken place at the Jasper County Site.

Exposed Areas

Areas exposed to the released hazardous substances include the waters, wetlands, streambanks, sediments, soil and biota of the Newton County Mine Tailings Superfund Site. In addition, areas downstream of the Newton County Mine Tailings Superfund Site may be impacted.

Exposed Water Estimates

The principal drainage system for Newton County Mine Tailings Superfund Site is Shoal Creek and its tributaries. Based on recent sampling data obtained by EPA from sampling conducted in May 2006, Shoal Creek has approximately 12 miles of contaminated sediment. In addition, approximately two miles of upper Center Creek and four miles of Lost Creek have contaminated sediment originating from the Newton County Mine Tailings Superfund Site. These streams have been impacted by the release of hazardous substances as well as the intermittent channels, which provide flow to these streams.

Estimates of Concentrations

Samples of chat and tailings collected predominantly within the Granby DA by the EPA in 1995 had maximum Cd, Pb, and Zn concentrations of 195 mg/kg, 23,300 mg/kg, and 70,000 mg/kg, respectively. The mean concentrations, based on 19 samples, of Cd, Pb, and Zn were 132 mg/kg, 2715 mg/kg, 46,147 mg/kg, respectively (U.S. EPA, 1995).

Average concentrations of cadmium, lead and zinc in the shallow aquifer of the Newton County Mine Tailings Superfund Site exceed background concentrations by up to one order of magnitude. Mean cadmium concentrations in surface water are as high as one order of magnitude greater than background, and mean lead and zinc concentrations are as high as two to three orders of magnitude above background. Cadmium, lead and zinc concentrations in sediments of affected areas are greater than site background concentrations by one to two orders of magnitude. Soil cadmium, lead and zinc concentrations in Newton County are elevated over background concentrations by as much as one to two orders of magnitude.

Sediment samples collected by the EPA in Shoal Creek have exceeded the MacDonald Consensus-Based SQGs TEC and/or PEC for zinc, lead, and/or cadmium at the confluence of tributaries that drain the DAs in Newton County. The maximum zinc concentration found in Shoal Creek was 2410 mg/kg. Maximum concentrations of cadmium and zinc were 77 mg/kg and 25,000 mg/kg, respectively, in Gum Spring Branch below the Granby DA. The maximum concentration of lead was 1100 mg/kg in Wolf Creek (U.S. EPA, 1995). Fine sediment (less than 63 microns) collected by the U.S. Geological Survey near the Kansas state line contained Cd, Pb, and Zn concentrations of 14 mg/kg, 160 mg/kg, and 1600 mg/kg, respectively (Pope, 2005). Part of the investigation of the Jasper County site included sampling of Shoal Creek, which had a maximum Cd concentration of 147 mg/kg (Black & Veatch, 1998), two orders of magnitude greater than the site-specific background concentration. Shoal Creek had a maximum Zn concentration of 10,900 mg/kg, over eight times greater than the site-specific maximum background concentration. MacDonald et al (2000) identified consensus-based PECs for sediments of 128, 459, and 4.98 mg/kg for Pb, Zn and Cd, respectively.

Potentially Affected Resources

Natural resources and their supporting ecosystems that have been or potentially have been affected by the discharge or release of the hazardous substances, include but are not limited to groundwater, surface water, sediments, and biological resources including aquatic and terrestrial plants and microorganisms; aquatic and aquatic dependent mammals; fish; aquatic invertebrates; terrestrial invertebrates; and migratory birds including waterfowl, shorebirds, raptors and songbirds.

Site response investigations have documented impacts to groundwater, surface water, sediments, and terrestrial environments (U.S. EPA, 1995). For terrestrial environments, concentrations of cadmium, lead and zinc at un-vegetated and partially vegetated mine wastes are on average one to three orders of magnitude greater than background soil concentrations. Soils within 200 feet of mine waste piles contain cadmium, lead and zinc concentrations that are on average one order of magnitude greater than background soils with maximum concentrations up to three orders of magnitude greater than background. Concentrations of hazardous substances including cadmium, lead, and zinc in and adjacent to mine wastes greatly exceeds the national and state average soil concentrations and concentrations known to be toxic to individual plant species (Dames and Moore, 1995; Kabata-Pendias and Pendias, 1992).

Mine water, seeps, and ponds are sources of cadmium, lead and zinc. Flooded mine shafts contain highly elevated concentrations of metals. Measured concentrations of zinc in one mine opening exceeded the estimated acute toxicity threshold for warmwater fish.

Surface water samples draining abandoned mine sites and from the shallow aquifer contain concentrations of hazardous substances including cadmium, lead and zinc that exceed Safe Drinking Water Act criteria and State of Missouri groundwater standards (10 CSR 20-7.031). In some locations, these hazardous substances exceed the criteria by up to three orders of magnitude.

Degraded groundwater quality at the site also has ecological significance. The Ozark cavefish (*Amblyopsis rosae*) lives in caves and small openings that exist within the Springfield Plateau Aquifer. This aquifer is one of the primary zones where mining occurred. Since the aquifer is habitat for the Ozark cavefish and other cave dependent species, Aquatic Life Criteria are applicable. The Clean Water Act Aquatic Life Criterion for lead, zinc, and cadmium (which is hardness dependent) of approximately 5 ppb, 200 ppb, and 2 ppb for groundwater with hardness in excess of 200mg/L is exceeded in large areas across the site.

Contaminated sediment and surface water in Newton County potentially impact aquatic species through direct exposure from water or ingestion of contaminated prey, which have themselves ingested site-related metals. Two threatened and endangered candidate

species, the Natchez Mudpuppy (*Ameletus nebulosus*) and Arkansas Darter (*Etheostoma*

system. The threatened Neosho madtom (*Noturus placidus*) occurs in the Spring River basin and may also be impacted by site metals. It is also a fish that lives and feeds within the sediment of site-impacted streams. These species are in direct contact with contaminated sediment, which exceeds the PECs, and are thereby at greater risk.

Declines in aquatic insect biomass and metal accumulation by aquatic insects are considered potential threats to the endangered gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*), thus interfering with ecological service flows. The threatened Ozark cavefish may be directly affected by degraded water quality at the site and the loss of prey base.

Contaminated soils may provide an exposure pathway to heavy metals contamination for the endangered American burying beetle (*Nicrophorus americanus*) as well as migratory birds. Depending upon the species, migratory birds will feed on terrestrial seeds and berries, soil invertebrates, fish, aquatic invertebrates, or aquatic plants.

Plant communities in the Newton County Mine Tailings Superfund Site have been highly modified to the extent that they now provide limited wildlife habitat. The phytotoxic effects of hazardous substances in mine wastes may be responsible for some or all of the observed injuries to the vegetative communities. Mead's milkweed (*Asclepias meadii*), classified as threatened, is a long-lived tallgrass prairie perennial herb, which exists in mesic to dry mesic upland prairie. Running buffalo clover (*Trifolium stoloniferum*) is an endangered legume that grows in disturbed bottomland meadows and is native to Newton County. Habitat loss represents the greatest past, present and future threat to these species.

Other Considerations

Data is available to document the initial severity of contamination and extent of degradation of environmental quality at the Newton County Mine Tailings Superfund Site. Onsite response investigations document impacts to groundwater, surface water, sediment, and terrestrial environments. Four hundred residential wells exceeded the MCL for lead and cadmium. The EPA supplied bottled water to residents with contaminated wells. Contaminated residential yard soils were removed to address human health risks. The Jasper County Site ERA developed data indicating degradation of surface waters and terrestrial environments. The ERA indicated an unacceptable risk to terrestrial wildlife that consumes ground dwelling invertebrates. The contaminants found at the Newton County Mine Tailings Superfund Site are similar to mining-related contaminants that were and are continually released through the mining, milling and smelting processes that have taken place at the Jasper County Site. Response actions implemented as well as those planned and evaluated in the assessment area will not sufficiently restore, replace, or provide compensation for injured natural resources without further actions.

PRE-ASSESSMENT SCREEN DETERMINATION

Based upon a review of readily available data and an evaluation of the preassessment determination criteria, summarized in this document, the Trustees have reached the following conclusions:

1. Discharges or releases of hazardous substances have occurred;
2. Natural resources for which the Trustees may assert trusteeship under CERCLA and FWPCA have been adversely affected by the discharge or release of hazardous substances;
3. The quantity and concentration of the released hazardous substances are sufficient to potentially cause injury to natural resources;
4. Data sufficient to pursue an assessment are readily available or likely to be obtained at a reasonable cost; and
5. Response actions planned will not sufficiently remedy the injury to natural resources without further action.

The Trustees hereby determine that further investigation and assessment is warranted and should be carried out at this site in accordance with Federal Regulations at 43 CFR §11, Subparts C and E. The Trustees further determine that current information indicates that there is a reasonable probability of making a successful natural resources damage claim pursuant to section 107 of the CERCLA and section 311 of the FWPCA and that all criteria and requirements in 43 CFR Part 11, generally, and 43 CFR 11.23(a)-(g), §11.24 and § 11.25, specifically, have been satisfied.

The information provided and conclusions made in this Preassessment Screen shall be used to direct further investigations and assessments and is not intended to preclude consideration of other resources later found to be affected or other parties found to be responsible for releases.

References

Allert, A.L., M.L. Wildhaber, C.J. Schmitt, D. Chapman, and E. Callahan. 1997. Toxicity of Sediments and Pore-waters and their Potential Impact on Neosho Madtom, *Noturus placidus*, in the Spring River System Affected by Historic Zinc-Lead Mining and Related Activities in Jasper and Newton Counties, Missouri; and Cherokee County, Kansas: Final Report to the U.S. Fish and Wildlife Service, Columbia Missouri. Prepared by U.S. Geological Survey Biological Resources Division, July.

Barks, J.H. 1977. Effects of Abandoned Lead and Zinc Mines and Tailings Piles on Water Quality in the Joplin Area, Missouri. U.S. Geological Survey Water Resources Investigations 77-75. August. 49 pp.

Black & Veatch. May 1998. Jasper County Superfund Site Baseline Ecological Risk Assessment (ERA), Jasper County, Missouri. Final. Prepared for the U.S. EPA Region VII by Black & Veatch Special Projects Corp.

CDM. 1995. Addendum to the Site Characterization Report in Support of Remedial Investigation Activities for the Iron Gate Extension Area for the Iron Gates, Belleville, and Klondike Designated Areas of the Jasper County Site, Jasper County, Missouri. Prepared for the U.S. EPA by CDM Federal Programs Corporation. November.

Dames & Moore. 1995. Volume I Final Remedial Investigation Neck/Alba, Snap, Oronogo/Duenweg, Joplin, Thoms, Carl Junction, and Waco Designated Areas, Jasper County Site, Jasper County, Missouri. Prepared for the Jasper County Respondents and the U.S. EPA, Region VII. October.

Fitzpatrick, L.C., B.J. Venables, and J.A. Mota. 1999. Study of Indigenous Earthworms at the Jasper County, Missouri Superfund Site: Relationships of Earthworm Distribution, Abundance and Body-burden Concentrations of Cd, Pb and Zn to Metal Concentrations and Physico-chemical Properties of Soil, and Potential Toxicity Associated with Exposure to Soil Metals. Prepared for Environmental Management Services Co., Fort Collins, CO. December 9.

Kabata-Pendias, A. and H. Pendias. 1992. Trace Elements in Soils and Plants. CRC Press, Boca Raton.

MacDonald, D.D., Ingersoll, C.G. and Berger, T.A. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39, 20-31

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

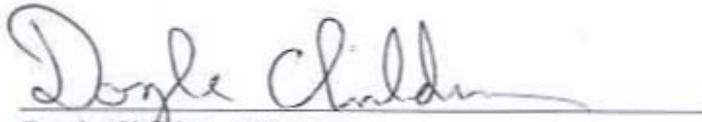
Historic Zinc-Lead Mining and Related Activities in the Tri-States Mining District on Aquatic Ecosystems Supporting the Neosho Madtom, *Noturus Placidus*, in Jasper County, Missouri; Ottawa County, Oklahoma; and Cherokee County, Kansas. Final Report. Prepared by U.S. Geological Survey for the U.S. EPA, Region VII. January 27.

Spruill, T.B. 1984. Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas. USGS Open-File Report 84-439. 102 PP.

U.S. EPA, July 1995, Final Expanded Site Inspection Report for Newton County Mine Tailings Site, Newton County, Missouri. Prepared by Jacobs Engineering Group, Inc.

Wildhaber, M.L., A.L. Allert, C.J. Schmitt, V.M. Tabor, D. Mulhern, and K.L. Powell. 1998. Both Contaminants and Habitat Limit Neosho Madtom (*Noturus Placidus*) Numbers in the Spring River, A Midwestern Warmwater Stream Affected by Runoff From Historic Zinc and Lead Mining. 9-13 pp.

MISSOURI DEPARTMENT OF NATURAL RESOURCES



Doyle Childers, Director
Missouri Department of Natural Resources

12-4-07

Date

U.S. DEPARTMENT OF THE INTERIOR



Benjamin Fuggle, Director
Region 2
U.S. Fish and Wildlife Service
U.S. Department of the Interior

1/3/08

Date