Comments to Draft Southeast Missouri Ozarks Regional Restoration Plan and Environmental Assessment

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1.0 INTRODUCTION

On September 20, 2013, the Missouri Natural Resource Trustee Council opened a public comment period for its draft regional restoration plan entitled, "Draft Southeast Missouri Ozarks Regional Restoration Plan and Environmental Assessment" (SEMORRP or "Draft Plan"). Federal trustees for this action include the U.S. Fish and Wildlife Service (USFWS) and the U.S. Forest Service (USFS). The State trustee is the Missouri Department of Natural Resources (MDNR). Collectively, these agencies are called the "Trustees." The Natural Resource Damages Assessment and Restoration (NRDAR) process under Section 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) contains four phases for assessing injuries and determining damages to natural resources: 1) Pre-Assessment Screen; 2) Assessment Plan; 3) Assessment; and 4) Post Assessment.

These comments to the Draft Plan are submitted on behalf of The Doe Run Company (Doe Run). Doe Run has reviewed the Draft Plan and considers it fundamentally flawed in its base assumptions and the associated supporting documents that form the impetus of the need for restoration, and flawed in its content and level of analysis. Our comments address both specific elements and aspects of the Draft Plan as well as many of the underlying assumptions that have been made by the Trustees to assign responsibility for natural resource damages associated with historical mining wastes within the Southeast Missouri Lead Mining District (SEMOLMD). This document is organized to provide comments to the following:

1. Comments on the Draft Plan Including Base Assumptions; and
2. Comments Related to Trustee Documents Prepared in Support of the NRDAR Process

There are key themes that reflect flaws in the Trustees' approach to NRDAR which are infused into the base assumptions of the Draft Plan **and** that permeate the NRD supporting documents. Those themes include the following:

- *Failure to Recognize Natural Baselines and Associate Injury with Identified Releases.* A key flaw of the Trustees' approach is the failure to recognize the presence of naturally occurring metals in the environment and other metals left behind by early mining that contribute to non-injured baseline conditions of aquatic and terrestrial ecosystems. Further, the Trustees not only fail to identify CERCLA-related releases, but there is no supported basis for resultant injuries and related damages that are the subject of the Draft Plan.
- Causation: A very important element of the NRDAR process is the establishment of a direct link from a release to the injury or loss of service suffered by the affected resource. Causation attributable to specific release(s) has not been sufficiently established through the NRD assessment phase (Phase 3). The Trustees have not provided a sufficient basis for the identified and suggested damages and subsequent loss of ecosystem services.

- *Study Plan Validity*: A critical flaw in the development of Study Plans under Phase 2 of the NRDAR process was the failure to design studies in a manner that would allow for the collection of a sample size necessary to report statistical significance for the magnitude of damage estimates made through the extrapolation of the resulting data. Furthermore, Study Plans do not provide methods that allow for proper identification of "baseline" conditions that exist in the terrestrial and aquatic environments in the absence of alleged releases.
- *Overestimation of Level of Injuries:* Another important element in the NRDAR process is a correct estimation of the degree and extent of injuries sustained by the affected natural resources. In the information developed in Phase 3 of the NRDAR process, the Trustees have failed to detail a valid basis for identified and suggested damages and subsequent loss of ecosystem services. Data obtained during the Assessment Phase is limited in scope and grossly extrapolated to large land areas resulting in an overestimation of injuries.
- *Failure to Demonstrate Loss of Services*: One of the most critical aspects of determining damages is the estimation of the impact to services caused by the injured resources. In Phase 3 of the NRDAR process, the Trustees failed to provide any demonstrable connection between documented injury and a loss of natural resource services. The Trustees have failed throughout their assessment to identify services provided by resources and to quantify the degree to which those services have been affected. The demonstration of any causative connections is weak or circumstantial at best. Without the development of changes in services brought about by the injuries to natural resources, there is limited ability to accurately estimate the appropriate level of damages.
- *Loss of Use:* In Phase 3 of the NRDAR process, the Trustees have not provided details on the basis, process, and/or the specific calculations they use to assess "loss of use" or "loss of experience.". This process, along with all aspects of the NRDAR, is required to be transparent and supported with appropriate data/analyses.
- *Basis for Compensation:* The Trustees have not defined the basis of their calculations for damages.
- *Reliance on Future NRD Settlement Funds:* The Draft Plan assumes reliance on future NRD settlement funds prior to completion of the negotiation or adjudication process.

2.0 COMMENTS ON THE DRAFT PLAN INCLUDING BASE ASSUMPTIONS

The following represent comments to the direct content of the Draft Plan. Inappropriate assumptions, as indicated in the comments below, form the basis for substantive comment and review of the NRD supporting documents in Section 3.0.

1) *Failure to Differentiate Other Entities' Responsibility as Part of Damages to Natural Resources.* Doe Run notes that a fundamental assumption by the Trustees is that the "legacy of heavy-metal mining is responsible for injury to thousands of acres of terrestrial

habitat and hundreds of miles of streams." (Executive Summary, paragraph 3). Clearly the Trustees attribute the damages that are the subject of the Draft Plan to this legacy of mining related activity. However, the Trustees' basis for the Draft Plan is flawed as it does not differentiate injuries and resultant damages between the source of "future recoveries" (see above) and those that may have been attributable to other mining entities. The history of mining in the SEMOLMD is extensive and extends back to the 1700s when the region was first settled.

2) *Failure to Recognize the Effect of Non-Mining Stressors and Their Influence on the Condition of Environmental Resources.* The effect of other environmental stressors as a basis for the condition of natural resources within the SEMOLMD is not recognized or considered by the Trustees as a fundamental basis for the need of the Draft Plan (e.g., naturally occurring lead, dams, low water crossings, land use, agriculture, other point source and non-point source discharges) (ES, paragraph 3).

   Oddly however, the Trustees acknowledge that consideration of the effect of other stressors (both attributable to mining by others and those associated with non-mining) is indeed, a part of the process that needs to be considered as part of restoration. For example, in Section 2.1, paragraph 1, the Draft Plan acknowledges that the baseline condition is "the level of services that would have existed **but for the release"** [emphasis added].

   However, in the case of the SEMOLMD, surficial deposits of lead and other associated heavy metals are naturally occurring and were present in the environment and in the Big River watershed for thousands of years prior to human settlement and the initiation of anthropogenic activity in the region. Naturally occurring lead is pervasive throughout Big River floodplain soils that pre-date the European settlement horizon. Additionally, the Trustees provide little or no acknowledgement of the mining activities that were conducted during the surficial mining period (1720 to 1864) which contributed to the introduction of mine wastes into the Big River watershed. (Note: historical evidence of widespread surface or pit mining of lead is documented during this surficial mining period.) Further, no temporal distinction is made by the Trustees in the assignment of responsibility for "releases" and no clear definition of baseline condition (pre-European settlement, surficial mining period) is provided. Additionally, the process followed by the Trustees fails to distinguish conditions of natural baselines as well as effects associated with other stressors NOT related to commercial mining (e.g., land use alteration, logging, disturbances related to agricultural land use, effects of dams, effects of other point sources, etc.).

3) *NEPA Purpose and Need for Restoration Not Established.* Doe Run recognizes that the Draft Plan includes an Environmental Assessment and therefore serves as an integrated document that is intended to meet the requirements of the National Environmental Policy Act of 1969 (NEPA). As required by NEPA and its implementing regulations (40 C.F.R. Part 1500 and 43 C.F.R. Part 46) the project Purpose and Need of the Environmental Assessment must be established to justify the action under consideration. Fundamentally, the proposed action described in the Draft Plan considers broad-based and unspecified

restoration measures that are intended to compensate for injuries and resultant damages to natural resources. However, the Draft Plan does not provide a basis for the need for such compensation and, therefore, is founded on a flawed Purpose and Need. No information is provided that accurately and effectively characterizes the baseline conditions of the natural resources reputed to have been injured. Further, there is no recognition that naturally occurring lead and other metals, as well as surface materials left behind by two centuries of early mining, are present in the surficial geology and associated residuum within the SEMOLMD that have, in turn, become part of the terrestrial and aquatic environment. Accordingly, there is no substantive and quantifiable assessment provided that establishes the basis for the Purpose and Need.

The SEMORRP also discusses two other topics:

- *Residual injury after response actions (p. 13).* As discussed above, no information is provided that quantifies the actual need for restoration of residual injuries and, therefore, no basis for the Purpose and Need is established. Further, the need and basis for the restoration measures proposed are predicated on presumed damages to the natural environment. However, neither the Draft Plan nor its supporting reports and analyses effectively demonstrates injuries that are associated with identified releases. Accordingly, this discussion in the SEMORRP provides no technical basis for the project's supposed Purpose and Need.
- *The Southeast Missouri Lead Mining District* (p. 14). The Draft Plan states that the "primary impetus behind the creation of the SEMORRP is the availability of restoration funds recovered through the settlements identified…" (p. 14, paragraph 1). Of course, the availability of funds, *per se*, does not establish a Purpose and Need. While the Draft Plan goes on to suggest that "Natural Resource Damage Assessments have shown heavy metal contamination affecting thousands of acres of land, dozens of miles of streams and terrestrial and aquatic life that depend on these habitats" (p. 14, paragraph 3), there is no quantifiable basis for this statement. Once again, the SEMORRP's discussion of this topic further undercuts and supposed Purpose and Need here.

4) *NEPA Alternatives are Undefined and Do Not Support Evaluation of Environmental Consequences.* Section 3 of the Draft Plan provides a description of the alternatives under consideration as part of this NEPA analysis. Alternatives include the following:

- Alternative A: No Action
- Alternative B: Primary Restoration of Injured Natural Resources
- Alternative C: Compensatory Restoration
- Alternative D: Tiered Project Selection Process Evaluating the Feasibility of Primary Restoration or Compensatory Restoration (Preferred Alternative)

The alternatives listed above are supported with superficial narrative that outlines general measures that may be undertaken as part of the consideration of restoration measures aimed at addressing cited damages. However, no substance is given for alternatives under consideration that can be reflected in a quantifiable, measureable manner that would

support the analysis of costs or benefits (advantages/disadvantages) relative to the environmental consequences. For example, no quantifiable data are presented that provide for relative benefits of the alternatives under consideration with respect to acres of habitats restored (wetland, upland, floodplain, etc.), the potential support for federally and state-listed Threatened and Endangered Species, control of invasive species, effects on agricultural production, contaminant removal, or other measures. Therefore, the formulation of project alternatives under consideration as part of this Environmental Assessment is fatally flawed and insufficient for analysis of environmental consequences.

5) *Affected Environment Poorly Documented and Not Sufficient Basis for Evaluation of Environmental Consequences.* While the Draft Plan includes a section entitled "Affected Environment" (Section 4), it is woefully inadequate and does not meet the requirements under NEPA or its implementing regulations for a full interdisciplinary analysis. Many environmental resources are omitted and are not characterized at all [e.g., air, noise, wild and scenic rivers, water use (surface water/groundwater), recreational uses, archaeological resources, historic architecture, visual/aesthetic environments, existing low income, minority or other special populations, and others], and those that are listed are supported by general descriptions (including the narratives given in Appendix D) and are inadequately characterized for NEPA review. It is also noted that no discussion or consideration of species proposed for listing under the Endangered Species Act is given in this narrative. In support of a proper NEPA evaluation in the context of considering restoration measures within SEMOLMD, the Affected Environment should detail the resources and their particular needs with respect to their impaired or injured condition to allow for the evaluation of environmental impacts (presumably benefits, but not necessarily) associated with restoration alternatives under consideration. As presented, the Affected Environment is not a complete baseline for evaluation of Environmental Consequences for each of the considered alternatives.

6) *Environmental Consequences Analysis Not Supported.* The Environmental Consequences section of the Draft Plan is markedly incomplete and insufficient for evaluation of alternatives under consideration.
   - First, the technical evaluation of alternatives does not follow established practices for demonstration of reasonable basis for conclusion of the environmental effects. General narrative is provided for many resources that provides a high level description of the environmental consequences, but there is no basis to support the conclusions given. As per appropriate NEPA practice, the assessment of environmental impacts should be supported by an analysis of "cause and effect" associated with each alternative and each resource under consideration. This analysis is not given. What is provided are generalizations that use terms such as "would provide…", "help create…", and "may benefit from…". Accordingly, the analysis is incomplete and not supported.
   - Second, discussions in the Environmental Consequences include topics that were not described in the Affected Environment. As an example, some discussion is given for both cultural resources and Environmental Justice, but there is no parallel

description of the resources or base condition in the Affected Environment. Accordingly the conclusions reached in the Environmental Consequences section (if even close to correct) are not supported.

- Third, it is noted that the Environmental Consequences section of this Draft Plan provides a brief assessment of cumulative effects associated with each alternative under consideration. While it is appropriate to include a discussion of cumulative effects, the analysis presented is wholly unsupported and does not follow the guidance for cumulative effects analysis provided by the Council on Environmental Quality (*Considering Cumulative Effects Under the National Environmental Policy Act*, Council on Environmental Quality, January 1997). As described by this guidance and the implementing regulations of NEPA (40 C.F.R. Part 1508.7), NEPA evaluations must consider the effects of the proposed action(s) under consideration in conjunction with other "past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions."

7) *Assumed Reliance on Future NRD Settlement Monies to Support Planned Restoration Efforts.* The Trustees state in the Draft Plan that the subject Draft Plan will be used to "describe the restoration objectives and processes for programming existing restoration funds as well as **future** [emphasis added] recoveries of restoration funds derived from the Natural Resource Damage Assessment and Restoration (NRDAR) process. " (Executive Summary, Paragraph 1). The basis for the Draft Plan, as reflected by the Trustees' reference to "future" funding obtained by recovery of damages from other NRDAR claims, assumes that further claims are justifiable and warranted. While Trustees may believe such claims are supported, the process for resolution of NRD claims is not complete. As such, reliance of this Draft Plan on future recoveries is inappropriate.

   The fundamental assumptions of the Trustees are critically flawed: the presence of naturally occurring surficial lead in the environment does NOT imply injury; injury is not demonstrated and not identified with a defined release; natural resource damage resulting from injury is not established and not attributable to an identified release.

3.0 COMMENTS RELATED TO TRUSTEE DOCUMENTS PREPARED IN SUPPORT OF THE NRDAR PROCESS

As described above (Section 2, Comment 1), the basis of the Draft Plan is, in part, predicated on the expectations of future funding obtained through the Natural Resource Damage claim process. Should that expectation of future funding be inappropriate or ill-founded, the basic need of the Draft Plan is not supported. Consequently, it is appropriate to examine the soundness of the Trustees' expectation for future funding that could support the actions considered by the Draft Plan. This section includes a general discussion of the NRD claim process as background information, and provides a discussion of key issues and deficiencies of Trustee documents.

3.1 Natural Resource Damage Claim Process Overview

A full and proper understanding of the NRDAR process is an appropriate background to the assessment of Trustee documents prepared in conjunction with the SEMOLMD. This section provides a brief overview of the NRDAR process as background to the summary of technical reviews of documents prepared by the Trustees.

The NRD claim process is a procedure for assessing and collecting damages for injuries to natural resources caused by a release of hazardous substances. NRD claim procedures are outlined in several different statutes, including CERCLA (Section 107) and the Clean Water Act (CWA) (Section 311(f)(4) and (5)).

The general concept behind claims related to natural resource injuries is that natural resources, which are managed by federal or state government agencies or Indian tribes, are available to the public for its use and enjoyment. Natural resources are defined under CERCLA as air, groundwater, surface water and sediment, geological materials, and biota.

The Department of the Interior (DOI) has trusteeship over inland resources including public lands, U.S. National Parks, U.S. National Wildlife Refuges, those lands managed by the Bureau of Land Management, Indian lands and natural resources held in trust by the federal government, and federally protected plants and animals including threatened and/or endangered species. The DOI has delegated its natural resource responsibilities to the USFWS and (in part) the National Park Service.

The NRD concept is contingent upon the theory that natural resources provide services to the public and these services have an economic value. Subsequent effects (or injuries) to the natural resources caused by a release or spill of hazardous substances results in a reduction of the value of those services. Loss of services is typically assessed in economic terms as “damages” that are subject to compensation. The responsible party is responsible to the public, through the Trustees, to make the public “whole” by paying damages for the lost services, for restoration of the natural resources to some pre-determined baseline or reference condition, and for the Trustees’ costs of conducting the Natural Resource Damage Assessment (NRDA). The Trustees are required to use recovered damages to restore, replace, or acquire the equivalent of the affected resource. Ultimately, the goal of the NRD claim process is the restoration of lost services through the implementation of selected restoration alternatives.

The injury (impact to the natural resource) is defined as a measurable adverse change in the chemical or physical quality or viability of a natural resource. It is important to note that, in theory, the injury determination process under an NRD claim evaluation is much stricter than a conclusion of an adverse effect in an ecological risk assessment, meaning that an ecological risk assessment may suggest the *potential* for an adverse ecological effect (risk), but that *potential* does not meet the NRD claim definition of an injury.

The NRD claim process has been divided into a series of sequential steps to define the activities needed to complete the process. Under CERCLA, the NRD claim process has been divided into four phases:

1. Pre-Assessment screen (PAS);
    a. Pre-Assessment screen;
    b. Pre-Assessment screen determination;
2. Assessment plan;
    a. Identify type of assessment procedure;
    b. Confirm exposure;
    c. Preliminary estimate of damages;
    d. Public review of plan
3. Assessment;
    a. Injury determination;
        i. Document natural resource injuries;
        ii. Determine exposure pathways linking releases and injuries;
    b. Quantification of service effects;
    c. Damage determination
        i. Restoration and Compensation Determination Plan;
        ii. Restoration;
        iii. Costs and valuation;
4. Post assessment

A factor that is taken in consideration in NRD claim actions is the concept of "services." Services are those physical and biological functions performed by the natural resources, including human uses of those functions. Services can be ecological, recreational, or commercial. Services have both "use" value (i.e., economic value of a resource resulting from direct public use of the resource or the service it provides) and "non-use" value (i.e., value of a resource in terms of willingness-to-pay by the public to avoid injury or loss of a resource that the public does not plan to use).

As the amount of any monetary damages and the ultimate restoration of those resources is tied to the services offered by the resources, service quantification becomes a critical part of the NRD claim process. Not only do the injured resources have to be quantified, but the services they offer have to be quantified under both baseline and post-release conditions. The term "baseline" is appropriately defined as related to all background conditions (either natural or anthropogenic) that may be associated with other environmental stressors "but for the release" in question. Additionally, "post-release" conditions are those that specifically are attributable to the release. **In short, direct causality with the release must be established to evaluate injuries and loss of services**. The difference between the two, the reduction in services, is used to support both the calculation of damages and the planning for restoration.

3.2 Phase 1: Pre-Assessment Screen

As stated in the Draft Plan, this phase of the NRDAR process is based on readily available information to determine if additional assessment is warranted and whether there is a reasonable probability of making a successful claim. Five criteria (43 CFR 11.23(e)) must be met and notification provided to the potentially responsible parties prior to moving forward with the next phase:

1) A discharge of oil or a release of a hazardous substance has occurred;
2) Natural resources for which the Federal or State agency or Indian tribe may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the discharge or release;
3) The quantity and concentration of the discharged oil or released hazardous substance is sufficient to potentially cause injury, as that term is used in this part, to those natural resources;
4) Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost; and
5) Response actions, if any, carried out or planned do not or will not sufficiently remedy the injury to natural resources without further action.

The Trustees prepared a number of Pre-Assessment Screen (PAS) documents that form the basis of the NRDAR process for the SEMOLMD including the following:

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2008a. Pre-assessment Screen and Determination; Big River Mine Tailings Site.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2008b. Pre-assessment Screen and Determination; Sweetwater Mine and Mill Complex, West Fork Mine and Mill Complex, Glover Smelter Site.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2009a. Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2009b. Response to Public Comments on the Draft Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites, August 2008.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2009c. Pre-assessment Screen and Determination; Viburnum Trend Lead Mine Sites.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), 2010. Addendum to Final Phase I Damage Assessment Plan (January 2009) for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site, St. Francois County and Viburnum Trend Sites, Reynolds and

Iron Counties.

Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS), Big River Mine Tailings Site, Southeast Missouri Lead Mining District, Addendum, Pre-assessment Screen and Determination.

The objective of the PAS is to review readily available information regarding the subject areas and, using the criteria above, make a determination whether releases of hazardous substances from the sites have the potential to impact natural resources. The PAS follows a defined format of providing site information, confirmation of any exclusion from liability under CERCLA, and then making a determination of the need for further investigation and assessment. At this stage, PAS documents do not need to substantiate the factual basis for any claim, but simply state that the readily available information indicates that the concentrations of hazardous substances are at levels that could potentially result in injuries to natural resources held in trust. This is the conclusion that was reached for the following sites:

- Sweetwater Mine and Mill Complex
- West Fork Mine and Mill Complex
- Glover Smelter Site
- Big River Mine Tailings Site (BRMTS; Primary report and Addendum)
- Viburnum Trend Lead Mine Sites

Much of the determination made in the PAS documents is based on information collected as part of the ASARCO bankruptcy.

In reviewing the data provided in the PAS, there are a number of concerns relative to the adequacy of the surface water and sediment sampling used to support the determination of a potential injury. Of particular concern is that the assessment of potential injury to sediments was based on comparison to inappropriate screening levels and not actual assessments of toxicity such as bioassays or benthic invertebrate surveys. This is the case for the PAS of the BRMTS. The same is noted with biological resources such as plants in which the assessment of potential injury is based on comparison of concentrations of metals in soils, but no causal demonstrations of the connection between plant loss or injury and site-related releases is made.

While the basis documents for each of the above referenced sites are noted to be “preliminary” in nature and founded on largely qualitative information, they reflect a flawed process that is perpetuated throughout the Trustees’ NRD claim process. In particular, the Trustees fail to give any real consideration to the fundamental issues that must be addressed to support a factual claim; that is**, they do not appropriately consider the issues of baseline and the factors and influences on the pre-release condition**. In fact, the Trustees are aware of the regional geologic setting with respect to naturally occurring lead in native, un-mined soils within the SEMOLMD. Clearly the issue of naturally occurring lead is complex and the Trustees fail to recognize this complexity as part of the PAS. Additionally, while much publicly available information exists (State web sites) that identify and characterize the extensive mining history of

the region, no discussion in the PAS fully acknowledges that this history contributes to baseline conditions.

3.3 Phase 2: Assessment Plan

As stated in the Draft SEMORRP, assessment plans provided by the Trustees outline planned studies to determine injuries to natural resources and lost ecosystem services; provide an overview of environmental impacts; and describe the NRDAR process. The assessment plan is said to ensure that any natural resource assessment of potential injuries is conducted in a planned and systematic manner and that the methodologies chosen demonstrate reasonable costs. The Trustees have compiled a number of documents in support of the Phase 2 Assessment Plan as identified below:

Allert, A., J. Fairchild, and R., DiStefano, 2009. Appendix C (Effects of historic lead-zinc mining on crayfish density in the Big River in southeast Missouri) from Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites. Columbia Environmental Research Center, Columbia, MO

Besser, J. 2008. Appendix C (Toxicity of metal-contaminated sediments from the southeast Missouri lead mining district to freshwater mussels and amphipods) from Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites. Columbia Environmental Research Center, Columbia, MO

Beyer, W., Undated. Injury to birds in the Southeast Missouri Lead Mining District. Patuxent Wildlife Research Center.

McKee, M. 2008. Appendix C (Effects of Lead-Zinc Mining on Fish Density in riffle areas of the Big River (southeast Missouri)) from Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites. Missouri Department of Conservation.

MDNR, Undated. Map of Potential Bird Collection Sites

Pavlowsky, R., 2008. Big River Mine Sediment Assessment Project (2008-2009) Statement of Work, Ozark Environmental and Water Resources Institute, Missouri State University.

Stroh, E. Undated. Research Study Plan Title: Heavy metal effects on growth and survival of native floodplain species. Columbia Environmental Research Center, Columbia, MO

Stroh, M. and J. Weber, 2012. Sampling and Analysis Plan for the Viburnum Trend Lead Mining District Transition Zone Assessment Study. Missouri Department of Natural Resources (MDNR) and U.S. Fish and Wildlife Service (USFWS).

Struckhoff, M. 2008. Appendix C (Effects of Mining-Derived Metals Contamination on

Native Floristic Quality) from Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites. Columbia Environmental Research Center, Columbia, MO

U.S. Fish and Wildlife Service (USFWS), 2008. Appendix C (2008 Big River Sediment Sampling and Mussel Survey) from Final Phase I Damage Assessment Plan for Southeast Missouri Lead Mining District: Big River Mine Tailings Superfund Site and Viburnum Trend Sites. U.S. Fish and Wildlife Service, Department of Interior

USFWS, 2010b. Viburnum Trend Water and Sediment Sampling, Hines Emerald Dragonfly Survey. US Department of Interior. U.S. Fish and Wildlife Service, Department of Interior

Weber, 2012. The Distribution of Heavy Metals in Known and Potential Hine's Emerald Dragonfly (*Somatachlora hineana*) Habitat Near the Viburnum Trend Mining District of Southeast, Missouri, USA. U.S. Fish and Wildlife Service, Department of Interior

While the sampling and analysis phases of the studies have been completed, the following review of basic study design flaws should have been addressed by the Trustees before the plans were finalized. With the foreknowledge that these studies were going to be used in the NRDAR process, the lack of background/reference locations, the absence of statistical power, the inability of the study plans to derive cause-and-effect, and the inappropriate sample handling procedures should all have been addressed before the Trustees allowed the projects to proceed.

The Trustees' methods to assess the nature and extent of natural resource injuries had a number of technical deficiencies that undermine the conclusions of loss of ecosystem services and relationship to releases. Study plans were provided by the Trustees to ensure assessments of potential injuries to any natural resource were conducted in a planned and systematic manner (Draft Plan, p. 11). However, the absence of a systematic approach (i.e., methodical in procedure or marked by thoroughness) is a clear technical deficiency. For example, study plans included very limited effort to properly collect the required background data to determine baseline-lead levels; procedures for data collection and analysis were often inappropriate or overly general; small sample sizes were insufficient to determine magnitude of effects; no basis for identified and suggested biological impacts were provided; and there were significant data quality issues.

The Trustees' conclusions of injured natural resources, lost ecosystem services, and identified sources of those injuries lack scientific bases. All technical deficiencies in the Trustees' Assessment Plan need to be addressed to produce the quality of data necessary to meet stricter NRD claim defined injury (Final Report Findings p. 3) and to predict the extent of injury to natural resources with any accuracy.

1. Failure to Spatially and Temporally Differentiate Naturally Occurring Lead from Specific Releases

A key deficiency in most of the reports the Trustees use in support of the Draft Plan is the failure to differentiate between naturally occurring lead in the environment and the effects of releases by mining operations, or to distinguish between the effects of different mining operations (and presumably, their attributed releases). The SEMOLMD has several geographically and temporally distinct mining areas. Assessments of mining sediment within the SEMOLMD do not propose methods to evaluate historical analysis of the sources of sediment contamination (Pavlowsky, 2008; Pavlowsky, 2010; and Besser, 2008). In addition to the many lead mines in the region, there are hundreds of recorded non-lead mining operations within the SEMOLMD that have contributed to the historical and existing baseline conditions. Assessment plans that examine impacts in Big River and its tributaries (Allert, et al 2008; Besser, 2008; McKee, 2008; Pavlowsky, 2008; Roberts et al, 2009; Stroh undated, USFWS, 2008) fail to include methods to relate lead to any releases.

All of the assessment plans published by the Trustees fail to provide location-specific differentiation that is needed to identify the effects of releases relative to baseline. Selection of sample locations in (MDNR, Undated) and Stroh (undated) only describe the sample collection areas as "within the SEMOLMD" and do not address specific releases. Consequently, these and other study plans, by design, fail to differentiate between baseline conditions and injuries related to any release(s). For example, the plan by Besser (2008) included the collection of sediment samples from a total of 21 locations along the Big River, Meramec River, and Bourbeuse River, without identifying which might be located in areas that are impacted by particular releases. Similarly, sampling plans for water and soil in the Viburnum Trend (MDNR 2011; and USFWS, 2010b; MDNR, undated), sediment and mussels in Big River (USFWS, 2008), and crayfish in Big River (Allert, et al 2008) propose general sampling plans that do not address specific temporal limits related to particular releases.

2. Failure to Consider the Effect of Non-Mining Stressors and Their Potential Influence on Natural Resource Quality.

The assessment plans also fail to consider or demonstrate an understanding of the relative background of the area that contributes to baseline conditions used to establish injury. There are multiple stressors unrelated to mining that have, or potentially contributed to, a reduction in the quality of natural resources relative to pristine conditions. Such contributing factors potentially impacting environmental quality include the effects of naturally occurring lead, early mining, non-mining point sources including wastewater treatment plant discharges, general land use alteration related to urbanization of communities within St. Francois County and other areas, agricultural land uses, and the adverse effects of dams and low water crossings. In Besser (2008), the study plan assumed that mining-related metals were the only variables controlling the survival and growth of mussels and amphipods. There is no mention of other potential inputs (municipal, industrial, agricultural, roadway, etc.) for the 90-mile study reach and the stresses they represent on the aquatic ecosystem.

In addition to the general lack of understanding related to background, the Trustees' studies attempt to use a single upstream reference, or a location on a tributary stream, as background for 90+ miles of stream (e.g., Besser 2008), with no accounting for potential contaminant inputs along the way, or inclusion of periodic reference samples to recalibrate the dynamically evolving "background" conditions. Also, many of the sample locations were selected downstream of highway bridges, municipalities, agricultural operations, and other environmental stressors, though the only stressor to which impacts were attributed in any of the Trustee studies was mining.

Galena and other naturally occurring lead-bearing materials are commonly present at the surface within the region and have eroded into the soils, streambeds, and floodplains over millions of years. This contribution of naturally occurring lead is an important component of the background that could vary spatially depending on historic erosion rates. The proposed work plans by Pavlowsky (2008 and 2010) lack a component that evaluates the age of sediment deposition within the Big River watershed and its tributaries. Also, without consideration of the temporal component to floodplain stratigraphy, study results are not capable of attributing those sediments deposited to any release, much less distinguishing between releases.

3. Inappropriate and Overly General Analytical Procedures and Approaches

Overly general analytical procedures and approaches (e.g., uncertain or biased samples sites, biased sample methods, and unspecified statistical analyses) were identified 22 times in 9 of the work-plan documents provided by the Trustees. Sample site selection, both spatially and temporally, were at issue in 5 of 12 work plans where no selection criteria were described (Pavlowsky, 2008; USFWS, 2010a; Stroh, undated), sample locations were ambiguous (USFWS, 2008), or no sample time frame was provided (MDNR 2009). These data issues call into question the Trustees' ability to determine significant injury and the relevance of these conclusions. For example, in the study: *Heavy metal effects on growth and survival of native floodplain species* (Stroh, Undated), selection criteria and locations for sample sites were not specified beyond "several locations along the Big River and its tributary Flat River Creek" and might not be applicable to other sites. Additionally, when samples were taken has implication for presence/absence of seasonal-migratory birds and bioavailability/exposure to contaminants in the study: *Injury to birds in the southeast Missouri lead mining district* (Beyer, Undated). Where sample location data were elucidated, biased sample locations were identified in 2 studies. For example, among the seven sample locations selected for evaluation of potential effects to Hines emerald dragonfly, only a subset was identified as having suitable habitat quality (based on factors unrelated to metals concentrations) (USFWS, 2010b). Additionally, sample sites located at "convenient access points" imply reduced-gradient areas near roads that are biased towards higher concentrations of metals in sample media (sediment and water). Resultant data from these biased sample sites would have a greater chance of finding a false covariate effect.

Questionable and unsubstantiated methods (e.g., spatially unrelated samples, biased samples, and model limitations) were an issue in a number of studies and limited the usefulness of any subsequent findings. For example, methods for estimating metal exposure in mussels collected in riffle habitats tested sediment-metal concentrations from adjacent slack water habitats (i.e., non-mussel habitat). This approach assumes similar levels of metals exposure between habitats with different substrate compositions and is biased towards the finer sediments more prevalent in depositional habitats. Sediment-sample bias towards fine sediments (e.g., sieved down to < 2-mm grains) was also present in several other study plans (e.g., freshwater mussels and amphipods of Besser (2008); sediment and surface water sampling of USFWS (2008)). It is well established that metals adsorb to sediment particles and the finer the sediment (i.e., higher surface area to mass ratio) the higher the potential metals concentrations. However, testing the metal concentrations of fine-sediments increases the chance of finding significant toxicological effects and is not reflective of environmental conditions.

Similarly, the study plan of Pavlowsky (2008) did not demonstrate a thorough understanding of the application and limitations of sediment transport equations. For example, no methods were provided for modeling sediment transport, sampling to assess sediment transport, and establish continuous monitoring of sediment transport for the Big River main channel, tributaries, and floodplains. Any conclusions drawn from these studies are therefore, speculative at best.

Incorporation of *a priori* methods of analysis is of paramount importance to avoid post hoc methods of data analysis (i.e. data mining) which are unsupported by scientific theory and unable to test hypotheses and estimate precision (Anderson et al, 2000). However, no *a priori* statistical analyses, or insufficient descriptions of analyses, were provided in 5 of the Trustees' study plans. For example, no methods for statistical analysis, statistical targets (e.g., α level), data explorations, data manipulations, and theoretical assumptions were included in the studies of native floodplain species (Stroh, undated), sediments and surface water sampling (MDNR, undated), Hine's emerald dragonfly (HED) survey (USFWS, 2010b), crayfish survey (Allert et al., 2008), and mussel survey (USFWS, 2010a).

Statistical methods for testing soil-metal concentrations were presented in the HED survey, but no methods tested for the biologically relevant effect of soil-metal concentrations on the presence or absence of the HED. Also at issue was the use of a "straw man" approach or the use of a known false-null hypothesis to test for "long-term" changes in mussel communities (USWFS, 2008). Biotic communities fluctuate over time and the Trustees' analysis is biased towards finding an effect without specific methods to isolate the effects of mine-derived metals from non-mining-related effects. Without consideration of *a priori* methods of analysis these studies cannot make reliable inferences about the populations sampled (Anderson et al., 2000) and should be viewed with caution (Zuur et al., 2010).

4. Insufficient Quantity of Samples to Support the Magnitude of Injuries and Potential Claims.

In addition to those studies lacking *a priori* descriptions of analyses, insufficient quantity of samples was also identified as an issue. The numbers of replicates per treatment were not identified (Stroh, undated) or were often not enough (e.g., 1 – 10 samples per stream) to capture the spatial variation inherent in each stream (MDNR, undated). Moreover, reference sites that establish a baseline need to be properly replicated to capture variability between spatially distinct areas. Only one reference site was described in the HED survey (USFWS, 2010b) and the bird survey (MDNR, 2009). Without clear replication of treatments and reference sites there is:

1. No estimation of statistical power;
2. Underestimation of true variation;
3. Increased chance of Type I error; and
4. Consequently limited or invalid conclusions (Heffner et al., 1996).

Other study plans, in which a notable deficiency in the quantity of samples planned relative to their proposed application to larger ecological land areas, included those by Beyer, undated; MDNR, undated; Struckhoff, 2008; and Stroh and Weber, 2012;

5. Failure to Provide a Supportable Basis for Identified Biological Impacts

Failure to address other factors that influence response variables (e.g., sediment loads and biotic fluctuations) erodes the basis for identified and suggested biological impacts in several study plans. For example, no inclusion of relevant abiotic factors (e.g., streamflow variations, historic erosion, aging of sediments, etc.) in the *Big River mine-sediment assessment project 2008 – 2009* (Pavlowsky, 2008) grossly oversimplifies the models used to estimate damages from releases of mine-derived metals. Biologically relevant factors that influence the fitness of aquatic biota (USGS, 2008) and floodplain vegetation (Stroh, undated) were also ignored in Trustee assessments. For example, substrate composition influences freshwater-mussel abundance and survival and soil-nutrient concentrations effect plant growth. Sources of metal contaminants are incorrectly assumed to be solely mine-derived releases as no other mentions of potential inputs (e.g., bridges, roadways, and urbanization) are discussed in the Trustee work plans (e.g., USFWS, 2008). Lack of consideration for other potentially significant factors and sources of metals contamination greatly reduces the ability of the Trustees to prove ecosystem injury and relationship to any particular release.

6. Failure to Consider or Collect Data Necessary to Evaluate Bioavailability of Metals In Various Media

The Trustees' study plans include sampling methodology that skews the analysis of the bioavailability of metals and potential toxicity within habitats of the Big River. Assessment plans for measuring toxicity of metals to mussels and amphipods (USFWS, 2008) and crayfish (Allert et al., 2008) in Big River proposed using only the fine fraction of the sampled sediment rather than the bulk sediment. As stated above, it is well-established that finer sediments have higher potential metals concentrations and sieving out the coarse sediments will bias the study designs toward significantly higher metals concentrations than what is found in the natural environment.

Additionally, the study plans propose to collect sediment samples from locations dissimilar from that which is actually inhabited by target organisms. For example, proposed study plans of USFWS (2008) and Allert, et al (2008) prescribe sampling sediments from slack water habitats adjacent to riffle habitats to measure exposure of mussels, crayfish, and riffle-oriented fish to metals; however, these target organisms are commonly found in gravel and rocky substrate common in riffles rather than the depositional areas proposed for sampling. Measurements of toxicity due to exposure to the biased fines fraction of sediment are a misrepresentation of the actual bioavailability of metals and are not representative of any actual exposure to aquatic biota.

7. Failure to Properly Examine Metals Speciation and Relative Changes in Ecotoxicology

Assessment plans that proposed to determine bioavailability of metals in sediment lack a consideration for metals speciation. Besser (2008) proposes that sediment collection include homogenization and sieving of the sediment. Metals bioavailability is strongly controlled by the pH, redox state, and the acid volatile sulfate-simultaneously extractable metals ratio of the sediment. The proposed sampling process would significantly alter these parameters. Consequently, the proposed assessment methodology both inaccurately represents actual river conditions, and inaccurately estimates bioavailability. Furthermore, bioavailability of metals is dependent on a number of water quality parameters that affect metals speciation, transport, and toxicity. The proposed study plans do not specify for collection of parameters of alkalinity, hardness, dissolved organic carbon, and concentrations of phosphate and other common anions (MDNR, undated). Without measurements for these parameters, evaluation of toxicity through biotic ligand models is not possible.

8. Failure to establish data quality objectives and use of improper QA/QC.

Improper quality assurance and quality control (QA/QC) and/or failure to establish data-quality objectives (DQOs) introduce yet more inaccuracy, due to the increased chances of investigator error and the decreased effectiveness of experiments and their conclusions. Much of the error inherent in field work and the less-accurate methods used to collect field samples can be corrected by using proper quality control monitoring. For example, sediment-metal concentrations were tested in the field using XRF methods, a portion of which were sent to the laboratory for more accurate follow-up testing (USFWS, 2010b). However, no methods were provided for how samples would be selected for confirmation analysis.

Presentation of spatial data was also deficient in maps of potential bird locations (MDNR, undated) and HED sample locations (USFWS, 2010b). No details on releases were included in the maps and the map of potential bird locations (for use in developing a sampling scheme to evaluate releases) and these maps even lacked basic elements (e.g., legend, scale bar, and north arrow) along with the source of the data. Even with these critical data gaps, the study plans were finalized.

3.4 Phase 3: Assessment

As stated in the Draft Plan, the purpose of the assessment phase is to collect, compile, and analyze data necessary to determine injury (exposure of natural resources to releases or discharges); quantify injuries (nature and extent of the injury); and determine damages (monetary value of injured resources plus compensable value of the services lost). The Trustees have compiled several Phase 3 Assessment reports and this section provides review comments on eight reports which are summarized herein.

Reviews of the Phase 3 assessment reports have identified a number of key deficiencies. Common deficiencies occurring in most of the assessment reports include inappropriate study design (see comments on Phase 2: Assessment Plan, above), failure to meet established DQO, and use of inappropriate reference areas for comparison with release-related study sites. Eight Phase 3 Assessment reports and their associated technical deficiencies are listed below.

1. Allert, et al, 2010. *Effects of mining-derived metals on riffle-dwelling crayfish and in-situ toxicity to juvenile* Orconectes hylas *and* Orconectes luteus *in the Big River of southeast Missouri, USA. Natural Resources Damage Assessment and Restoration Administrative Report for the United States Fish and Wildlife Service*.
    a. This assessment study/report employed inappropriate reference sites for comparison with study sites. Physical conditions such as substrate coarseness, water depth, and current velocity were different at the reference sites when compared to the mining and downstream locations. Lack of consistency in physical conditions between reference sites and study sites is the likely explanation for varying species composition and density, a factor not considered in the study.
    b. Food chain models indicated risk to robin, shrew, heron, and mink although the assessment report does not specify what toxicity reference values were used, or from what reference they were taken. Neither robin nor shrew are consumers of crayfish or benthic invertebrates and thus represent inappropriate study design.
    c. The highest food chain model hazard quotients were estimated for caged crayfish, but since the body burdens are artifacts of artificial test design and cannot be directly correlated with actual conditions in the field, results of this assessment report cannot be used to support the NRDAR.

2. *Besser, et al, 2009. Assessment of metal-contaminated sediments from the Southeast Missouri (SEMO) mining district using sediment toxicity tests with amphipods and freshwater mussels.*
    a. Study methods are not representative of conditions in the Big River. Sediment was sieved (≤2mm) to remove rocks and detritus and the resulting “bulk sediment” was sieved again (≤0.25mm) to derive “fine” sediment for the mussel study. The fine sediment fraction had an order of magnitude higher concentration of cadmium, lead, and zinc, than the bulk sediment. Because metals adsorb to sediment particles, the higher metals concentrations in the fine

sediment was due to the greater amount of surface area per milligram of fine sediment. Investigators, therefore, artificially concentrated sediment metals prior to using the sediment in the toxicity tests and, therefore, the tests were not representative of conditions in the Big River.

b. Amphipod sub-lethal effects (length and biomass) were reported to be statistically significant, but the shortest length (SEMO-13 at 3.34mm) showed a 4% reduction when compared to the reference location with the shortest length (SEMO-20 at 3.49mm), and the lowest biomass (SEMO-13 at 1.73mg) showed a 13% reduction when compared to the reference location (SEMO-20 at 1.99mg). While the ANOVA showed statistical significance, the de minimis level for a significant biological effect is typically defined as a 20% decrement (Suter, GW II, RA Efroymson, BE Sample, and DS Jones. 2000. Ecological Risk Assessment for Contaminated Sites. Lewis Publishers).

c. An objective interpretation of the results would conclude that there was no toxic effect to amphipods or mussels associated with the sediment samples and the findings are not appropriate for inclusion in NRDAR.

3. Roberts, et al, 2009. *An Assessment of Freshwater Mussel (Bivalvia: Margaritiferidae and Unionidae) Populations and Heavy Metal Sediment Contamination in the Big River, Missouri*.

a. This assessment study/report employed inappropriate reference sites for comparison with all study sites on the Big River. Reference sites on the Bourbeuse and Meramec rivers are characterized as being located in river reaches having lower channel slopes relative to the middle and upper portions of the Big River. While they do allow comparison to Big River sampling locations near the mouth of the Big River, they are not appropriate for comparisons to other reaches of the Big River. Physical conditions such as substrate coarseness, water depth, and current velocity were different at the reference sites when compared to the mining and downstream locations. Lack of consistency in physical conditions between reference sites and study sites is the likely explanation for varying species composition and density, a factor not considered in the study.

b. The authors admit that nationwide declines of freshwater mussel species have occurred as a result of numerous non-mining activities. This assessment report, however, attributed all variation to metals from releases resulting from mining activities. However, no consideration was given as to baselines associated with naturally occurring metals or to the assessment of injuries attributable to identified releases.

c. Comparison with prior studies on the Big River in 1979 demonstrated that catch per unit effort and number of species were similar or slightly better in 2008 than in 1979, suggesting that injury and service loss since 1979 is negligible or non-existent.

d. This study fails to evaluate the effects of other important environmental factors that are known to control unionid mussel populations. For example, the adverse

effect of dams on unionid mussels is well documented in scientific literature. However, Roberts, et al (2009) make no mention of the presence of five mill dams and numerous low water crossings and the known deleterious impacts that such features have on mussel communities.

e. This study and assessment report failed to meet established data quality objectives, making the results suspect. XRF data were collected at 39 locations and paired ICP/MS data were collected on 11 of the samples. The data quality objectives require paired data to be within ±30%. However, 65% of the lead samples and 45% of the zinc samples did not meet the DQO. While the investigators utilized a regression analysis to adjust the XRF data, this does not overcome the failure to present the ±30% for paired data.
f. Other key inaccuracies associated with this report included the following:
    i. Sediment samples for chemical analyses were not taken from mussel habitat (i.e., mussels and sediments not sampled from same location).
    ii. In an attempt to replicate the statistical analysis using data from Roberts, et al (2009), no significant negative correlation could be found between catch per unit effort (CPUE) and lead.
    iii. No information in Roberts, et al (2009) is provided for mussel size and/or age and therefore, no analysis is given regarding the extent to which successful recruitment is occurring or whether located populations are viable.
    iv. No consideration is given to species-specific tolerance differential as is commonly done with other invertebrates (*i.e.,* Hilsenhoff-type index for different mussel species).

4. Pavlowsky, et al, 2010. *Big River Mining Sediment Assessment Project: Distribution, Geochemistry, and Storage of Mining Sediment in Channel and Floodplain Deposits of the Big River System in St. Francois, Washington, and Jefferson Counties, Missouri*. Ozarks Environmental and Water Resources Institute, Missouri State University.
    a. The assessment report fails to adequately identify baseline metals concentrations in a region that is naturally rich in lead and other metals and has been mined for centuries. Such failure to address baseline conditions makes it impossible to separate the metals from the high natural background levels or from contributions of releases attributable to the many other companies that have historically mined in the area.
    b. No analysis or consideration is given to the potential for deposition within floodplains from naturally occurring lead that is represented in background concentrations.
    c. No analysis of the temporal aspect of floodplain stratigraphy is given to allow for association of floodplain soil metal concentrations with temporal periods such as those prior to modern human settlement of the region (prior to 1700s), the earlier surficial mining period (1700s to 1864 for lead, and continuing to 2000 for Washington Co. barite)), and the subsurface lead mining period (post 1864).

d. While Figure 1 in the report illustrates a substantial number of mine sites in the Mill Creek and Mineral Fork watersheds in Washington County, the authors conclude that the inputs of contaminants from these two major tributaries are insignificant, with only limited data to support the findings. The study data itself does not address the potential flux of contaminated sediments from these tributaries into the Big River. These findings must be re-examined using more scientific methodologies that take into account relationship between sediment transport and flow discharges in these sub watersheds. The conclusions in regard to the impacts of contaminants from the downstream tributaries such as Mill Creek and Mineral Fork were not supported with sufficient data and the impacts from these tributaries are significantly underestimated.
e. The findings on floodplain contamination processes ignore the effects of flow and historic flooding. The assessment report does not address the relationship between mining history, flood history, and sedimentation process within the Big River and its tributaries. It is not possible to accurately estimate contaminant loads within the channel and floodplain without considering the mechanics of sediment transport, flow discharges, and the resultant contaminant flux.
f. The authors have oversimplified contaminant storage by making gross assumptions about the average depth of lead contamination in each 2 km long floodplain cell which is then multiplied by the floodplain surface area within the cell. This method of calculating the contaminated sediment storage is inaccurate because it lacks sufficient field data to support a reliable quantification.
g. The authors provide an overly simplistic conclusion that floodplains act as a source and sink for contaminants without any attempt to address the important interactions between stream flow within the main channel, floodplain areas, and fluvial geomorphic processes as related to the frequent, occasional, and rare high flood events.
h. The report provides some very generalized and limited more specific conclusions on Page 43 (Items 5, 7, and 8) regarding transport of mine tailings downstream, spatial distributions of contaminants and some statistics on the distribution of contaminants in each county. The authors focus on describing the data and rely on simple curve fitting techniques to draw conclusions. A more advanced statistical analysis is required to provide a more appropriate and accurate basis for a meaningful trend analysis to predict and evaluate contaminant transport processes and the resulting contaminant loads and distributions.

5. Weber, 2012. *The Distribution of Heavy Metals in Known and Potential Hine's Emerald Dragonfly (*Somatachlora hineana*) Habitat Near the Viburnum Trend Mining District of Southeast, Missouri, USA*.
    a. The investigators of this assessment report identify the acceptability criterion for the XRF analytical results by stating that "the measured value for each target analyte must be with ±20% (%D) of the true value." However, of the five XRF samples that were confirmed using ICP/MS, only three were within 20% for lead,

and none were within 20% for zinc. All of the XRF results were significantly higher than the ICP/MS results, yielding overestimated sediment metals concentrations. Because the data quality objectives were not met, all XRF results are suspect. As such, the data are not acceptable for screening environmental impact and are not appropriate for inclusion in NRDA investigations.

b. This assessment report is entirely hypothetical. Investigators collected samples from areas that could potentially support Hine's emerald dragonflies (HED), although they have no evidence to confirm that HED were ever present. The authors admit that HED have been extirpated from most of its historic range (Ohio, Indiana, and Alabama), and that only remnant populations remain. Clearly, causes other than mining are responsible for range-wide population declines. The report uses screening-level Threshold Effects Concentrations and Probable Effects Concentrations to infer that mining-related metals could impact a hypothetical population of HED. Hypothetical studies cannot be used to associate alleged injuries with Doe Run mining activities.

6. Stroh, et al, 2009. *Effects of Mining-Derived Metals Contamination on Native Floristic Quality*.
    a. This study employed inappropriate reference sites for comparison with mine waste sites. Reference sites with native soil cannot serve as comparisons with mine waste sites where the growing medium generally consists of coarse aggregate materials. For this reason, the reference sites identified serve no purpose in relation to mine waste sites.
    b. This study employed inappropriate reference sites for comparison with "contaminated" native soil sites. Reference Bottoms appear to be located high in the upland headwaters adjacent to intermittent streams and cannot be used as reference sites for mining-impacted areas along large perennial rivers where flood disturbance also impacts floristic quality.
    c. The authors conclude that their analyses demonstrate a negative effect of metals on plant communities. This general statement is unfounded when their data demonstrate otherwise. According to Swink and Wilhelm (*Plants of the Chicago Region*, 1994), one can be fairly confident that a site with a mean C value of at least 3.5 and an FQI of at least 35 is a site worthy of consideration as a natural area. The data in this study reveal that all 8 "contaminated" native soil sites have mean C values of 3.5 or higher and 5 out of 8 sites have FQI values of 35 or higher. These data show the sites to have good floristic quality.
    d. Exclusion of sampling from spoil sites results in a relatively small total sample area (less than 5 acres). The small number of sample locations/area leads to unreliable, if not wrong, findings by extrapolation of results to larger areas.
    e. As is indicated by Struckhoff et al (2013), Mean C and FQA do not relate to injury or loss of services. In fact, as indicated by the following quotes, these authors appear to acknowledge the limited applicability of FQA::

> *"…important to note that a species C value is not a measure of the value of that particular species as a provider of food, habitat or other ecological service, but rather a measure of sensitivity to disturbance."*
> *"…It is also important to note that, because both Mean C and FQI are calculated on species presence/absence data rather than size or physical condition of species, neither is able to capture non-lethal effects of disturbance."*

Thus, claims of injuries attributed to reductions to floristic quality in the SEMO district are un-supported.

7. Beyer, et al, 2013. *Toxic Exposure of Songbirds to Lead in the Southeast Missouri Lead Mining District.*

    a. The study based some of its determination of potential ecological impacts from levels of lead in surface soil on a comparison to levels identified in various CERCLA ecological risk assessment cases. However, there is no way to determine the adequacy of those studies. It is not known whether the ecological risk assessments were conducted using more than simply literature-based information, or whether the conditions of the sites evaluated are similar in nature to the SEMOLMD.
    b. There is no measure of the ecological relevance of the tissue studies. While the report mentions that the level of lead was in excess of those reported to cause adverse impacts, there is no evidence presented that the populations of songbirds have been affected by the levels of lead.
    c. Samples of surface soil and biological tissues were collected from a small number of locations in the SEMOLMD. However, there is no information relative to the association of any of these sites to releases. Additionally, the small number of sample locations leads to significant risk of misapplication of findings by extrapolation of results to larger areas. Finally, the effect of naturally occurring lead and/or early mining was never even considered.
    d. While samples from reference areas were collected, the comparison is between levels in pristine locations outside of the mining district and its natural levels of galena. To accurately ascertain the relative level of site induced risks, it is necessary to compare background samples within the mining district and examine the contribution of releases over and above those levels.

8. McKee, et al, 2010. *Effects of lead-zinc mining on benthic fish density in riffles of the Big River (Southeast Missouri)*. Final Report.

    a. Electroshocking was used to determine fish density riffles at each sampling site. The authors state that the block seine that was used during sampling was inefficient in very shallow or deeper riffles. This resulted in biased sampling at "intermediate" depth riffles. There are no data presented to determine if riffles at each of the study sites were sampled within the same depth range.

b. Sediment or water chemistry data was not collected as part of the study. Authors indicated that sediment and water metal concentrations used in their analyses were from mussel and crayfish studies conducted during a "companion study," but the collection date is not provided. Based on information in this report, there is also no way to determine how close the fish sampling locations were to the locations where the sediment samples were previously collected during the mussel and crayfish studies. Based on supplemental field sampling conducted by Doe Run in 2013 it is clear that depositional environments where sediment samples may have been taken are NOT collocated with riffles. Accordingly there is a major interpretive error in use of sediment data from habitats that are fundamentally dissimilar from those sampled by this study. A footnote on Table 3 of the report states that "All sites are from the same sites used in the riffle fish and crayfish studies except for R-2 and TL-1. For these sites, we selected the nearest mussel study site." There is no information as to where the mussel sites were in relation to the fish sites.
c. The report acknowledges that "no trend in species occurrence was apparent in relation to sediment metal concentrations, or upstream to downstream relationships", and "whole body concentrations of Pb and Cd in Missouri saddled darters were not significantly correlated with benthic riffle fish density." A high variability between the densities at the two reference sites is also mentioned. A review of fish density plotted by location (Figure 3) indicates that adult densities may be slightly lower at two of the downstream stations (TH-1 and TH-2). The other four stations are comparable to the reference locations. The authors also acknowledged that only one statistical test found a difference between reference and downstream fish densities. Given these equivocal or no-impact findings, the report has no scientific basis to conclude that there are negative correlations between riffle fish density and metals in sediment.
d. The ecological risk analysis using heron-darter predator-prey relationship is not accurate because the Missouri saddled darter is not a primary (or exclusive) prey species of the heron.
e. This study does not provide evidence of any measurable service loss in Big River. There was no significant change in fish length and the percent of juveniles actually increased with metal concentration, indicating the reproduction is not being affected.

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