Review Comments on Red Devil Mine Baseline Ecological Risk Assessment

Comments prepared by Burt Shephard, USEPA Region 10, May 2012

Response by Ecology and Environment, Inc. and BLM, August 2012

General Comments

1. EPA's earlier comments and recommendations on the screening level ecological risk assessment (SLERA) appear to have been acceptably addressed, and incorporated as needed into the SLERA. EPA anticipates no further changes are needed to the SLERA.

   Response: Acknowledged.

2. Unfortunately, the baseline ecological risk assessment (BERA) appears to be little more than a SLERA with a few areas of additional detail provided, or at best, a refined screen as per Step 3 of EPA's 8-step ecological risk assessment guidance. Particularly disappointing is the almost complete lack of effort to identify baseline toxicity reference values (TRVs) from the literature in the BERA, which instead relies on screening level benchmarks throughout. The absence of effort to find TRVs or literature for chemicals without screening level benchmarks is particularly notable during evaluation of risks from some of the chemicals with the highest concentrations in site media and biota, such as antimony. The relatively large number of chemicals whose risks could not be quantitatively evaluated due to lack of TRVs results in extensive uncertainty regarding the BERA conclusions, and likely leads to an underestimation of ecological risks. An effort must be made to identify TRVs or literature suitable for use in defining risks to receptors in those instances where risks could not be quantified. Several of the specific comments point to specific toxicological information which should be used to quantify risks in the BERA.

   Response: It is not accurate to state that the BERA relies on screening-level benchmarks throughout. For example, wildlife risks in the BERA were calculated based on lowest observed adverse effect levels (LOAELs) and no observed adverse effect levels (NOAELs). In the SLERA, only NOAELs were used. Also for example, the BERA used probable effect concentrations (PECs) as sediment benchmarks. The SLERA used the more conservative threshold effect concentrations (TECs). These are important differences between the BERA and SLERA and indicate that the BERA is not based solely on screening-level benchmarks. As described in the responses to Specific Comments 9, 14, and 19, the publications and websites identified by USEPA will be used as additional sources of ecological TRVs for chemicals without TRVs in the draft BERA. Risks for these chemicals will be calculated and presented in a revised BERA, thereby reducing uncertainties in the BERA conclusions.

3. A spot check of calculations identified no computational errors in the exposure point calculations or risk estimates, although Specific Comment 31 identifies an area of potential error which could not be evaluated given the information provided in the BERA.

   Response: See response to Comment 30.

4. The BERA is lacking in figures and maps that illustrate the locations and magnitudes of the identified ecological risks. As a primary goal of any BERA is to provide information to risk managers that allow them to make remedial decisions for the site, it is important that the locations and spatial extent of identified risks are presented in such a manner that the risk managers can make appropriate decisions. The BERA should contain figures illustrating the areas and extent of hazard quotients ≥ 1 for the various lines of evidence. Specific types of maps needed will not be identified here, instead, the specific types of maps to be developed should be identified during discussions with risk managers for the site.

   Response: Preliminary maps will be created for one or more of the principal chemicals of concern at the site and circulated to USEPA, Alaska DEC, and BLM for feedback. The preliminary maps will feature risk and/or concentration contours to enable risk managers to readily identify areas posing the greatest ecological risk. If possible, details regarding the final number and types of risk maps to incorporate into the BERA will be decided via e-mail exchange between E & E and the above-mentioned the agencies. If necessary, a conference call will be scheduled to discuss the matter.

Specific Comments

1. **Vegetative Cover, p. 6-55**. Are there any photographs or maps of site vegetation elsewhere in the document? If not, a few photographs of the site would be helpful in evaluating the suitability of the existing habitat for the ecological receptors evaluated in the BERA.

   Response: Photographs showing on-site vegetation are included in the draft RI report in the following locations:

   Page 1-7: Red Devil Mine in 1971, including the area of surface mining and exploration.
   Page 2-3: Surface soil sampling for XRF field screening
   Page 2-4: Surface soil sample collection.
   Page 2-22: Groundwater sample collection.
   Page 2-28: Surface water sample collection in Red Devil Creek.
   Page 2-31: Sediment sample collection in Red Devil Creek.
   Page 2-33: Kuskokwim River off-shore sediment sample collection.
   Page 3-17: The Red Devil Creek delta on the Kuskokwim River.

Additional photographs will be added to the BERA showing: (1) representative vegetation in the surface mined area, main processing area, and along Red Devil Creek; (2) settling pond vegetation; and (3) seep along Red Devil Creek (location RD05).

2. **Salmon species collected for chemical analysis, p. 6-56**. Section 6.3.2.4 discusses juvenile salmon collections for chemical analyses, but does not list the species of salmon collected. Correct this omission.

   Response: Two Chinook and one Coho juvenile salmon were collected from Red Devil Creek by BLM. This information will be added to the text.

3. **Algae species present in Red Devil Creek, p. 6-57.** The text discusses the presence of brown algae in Red Devil Creek. However, brown algae (Phaeophyceae) are very uncommon in fresh waters. Were the samples actually identified as brown algae? Or is it more likely that the algae appeared brown, an appearance in periphyton that is often due to the presence of diatom species? Clarify this section.

   Response: The algae appeared brown. The text will be clarified.

4. **Page 6-59, 3rd line from top of page**. Remove the phrase "based on EPA comments" from this sentence describing evaluations done as part of the SLERA.

   Response: The phrase will be removed.

5. **SLERA summary, p. 6-59 and Table 6-35**. It is unclear which organics without screening level benchmarks are included in Table 6-35. The table needs clarified as to which organics did not have screening level benchmarks, and which simply were not evaluated in the SLERA. A table footnote would suffice to clarify this issue.

   Response: The text and table will be clarified.

6. **BERA problem formulation, Section 6.3.4, 1st sentence, p. 6-59**. Sentence should read that problem formulation is the first step in the baseline risk assessment process.

   Response: The text will be revised as requested.

7. **Section 6.3.4.1, Contaminant Sources, p. 6-59**. The reference to the site investigation by the U is an incomplete reference, which should be amended to read USGS.

   Response: The typographical error will be corrected.

8. **Section 6.3.4.2, COPC refinement, p. 6-60**. The statement in the first paragraph "The other metals identified as COPCs in Table 6-35 appear to be of lesser concern" is a risk management conclusion that does not belong in a BERA. All identified COPCs are of concern at this stage in the remedial investigation process. Risk managers for the site

will make the final determination which COPCs and COCs are of greater or lesser concern for risk management and site remediation purposes at the conclusion of the RI/FS process. The sentence must be reworded to state that the other metals have lower hazard quotients and/or have HQs ≥ 1 over a smaller proportion of the site than do antimony, arsenic and mercury.

Response: The statement will be reworded as suggested.

9. **PAH and other SVOC toxicity data availability, Section 6.3.4.2, p 6-60**. As noted in General Comment 2, toxicity reference values are available for a number of the chemicals the BERA claims have no TRVs. Two useful place to start in identifying these TRVs would be the current NOAA Screening Quick Reference Tables and the Savannah River Ecology Laboratory benchmarks, which have benchmarks for many of the chemicals, both metals and organics, that the BERA claims have no TRVs and thus could not be quantitatively evaluated. The EPA Eco-SSL documents for individual chemicals contain references for many media-receptor pairs (e.g. toxicity of antimony in soil to plants) which may not have been sufficient to develop a soil screening level due to the lack of the required number of high quality studies, but which by themselves passed the data quality requirements for Eco-SSL development and thus provide some information useable to derive baseline ecological risk assessment TRVs for use at Red Devil Mine.

   Response: As suggested, the above-mentioned references will be used as additional sources of TRVs. New TRVs to be added to the BERA will be compiled and provided to USEPA and Alaska DEC for review and concurrence and/or the hierarch of references that will be used as TRV sources will be provided.

10. **Section 6.3.4.3, Ecological Receptors, p. 6-60 and 6-61, Table 6-36.** Aquatic plants should also be identified as an ecological receptor group among the aquatic biota. The comparison of measured chemical concentrations in surface water to aquatic biota TRVs such as water quality criteria will also serve to evaluate ecological risks to aquatic plants. This risk characterization needs to be carried through several sections of the BERA.

    Response: Aquatic plants will be added to the BERA as an aquatic ecological receptor group and evaluated as suggested.

11. **Section 6.3.6.1, benthic invertebrate and sculpin tissue data used in BERA, p. 6-63**. If a report of this data becomes available between the publication of the draft and final BERA, it, or at minimum a reference to it, should be included in the final BERA. EPA understands and agrees with the desire of the BLM to use this data in the BERA. At the very least, an electronic copy of the data needs to be supplied with the final BERA. If possible given the apparently draft status of the data, there should be an expanded discussion of the status of the report as of the completion date of the final BERA. Ideally, the final BERA should contain one or more tables summarizing this data.

Response: Additional information regarding the benthic macroinvertebrate and sculpin data from BLM will be added to the BERA to facility agency review. See also response to Specific Comment 20.

12. **Section 6.3.6.2, terrestrial vegetation exposure assessment and risk characterization, p. 6-64**. The handling and presentation of background risks in this section, and indeed within the entire BERA, are not consistent with EPA national policy regarding risks from naturally occurring concentrations of naturally occurring chemicals such as metals. EPA policy requires that all risks first be described and quantified in the risk characterization. Once this has been done, the comparison is then made to background concentrations. If site concentrations are below background concentrations, only then is the determination made that identified risks are due to naturally occurring background concentrations, and the chemical eliminated as a basis for remedial action at the site. The elimination of chemicals as posing unacceptable risks due to non-exceedance of background prior to the completion of the BERA is inconsistent with EPA policy. One acceptable method of presenting this information in the BERA is to carry through all identified risks to the completion of the risk characterization section of the BERA. A new section and appropriate tables should then be added identifying the chemicals whose risks are solely due to background concentrations.

    Response: As suggested, a section discussing background risks will be added at the end of the risk characterization section. Comparison of site with background risks will be confined to this section.

13. **Section 6.3.6.2, terrestrial vegetation exposure assessment and risk characterization, p. 6-64**. The bullet starting with "The cobalt HQ (1.4)" should be reworded as follows: "The cobalt HQ (1.4) and nickel HQ (1.4) at the RDM site were marginally greater than 1." The following sentence that begins "Because of the conservative nature . . ." should be deleted entirely, as it describes a risk management decision that cobalt and nickel are unlikely to pose actual risks to plants, implying risks are at acceptable levels. Risk management decisions are inappropriate in a risk assessment.

    Response: The bullet will be revised as suggested.

14. **Section 6.3.6.2, terrestrial vegetation exposure assessment and risk characterization, p. 6-64**. Statements such as no reliable screening levels are available for certain chemicals, such as antimony, barium and beryllium for terrestrial plants, are unacceptable in a BERA unless there has been a demonstration that an effort was made to identify or derive baseline ecological risk TRVs. As the BERA does not contain a toxicity assessment section, it appears little or no effort was made to identify information or literature that could be used as a source of baseline ecological risk TRVs. One specific source of information that can be used to derive soil TRVs for use in evaluating risks to

terrestrial plants is the literature EPA identified in the ecological soil screening levels to derive the Eco-SSL values. Although an insufficient amount of high quality literature was found to derive terrestrial plant soil TRVs using the Eco-SSL methodology, individual studies of sufficient quality were identified, and could be used to derive baseline TRVs. Another useful source of ecological risk TRVs for many chemicals and media is the Risk Assessment Information System (RAIS), hosted by Oak Ridge National Laboratory and found at the following website: http://rais.ornl.gov/tools/eco_search.php The RAIS data base contains toxicity data for many of the chemicals the BERA identifies as not having TRVs. For terrestrial vegetation specifically, RAIS makes reference to EPA Region 6 soil TRVs for terrestrial plants. RAIS also points in some instances to the Dutch target and/or intervention values for soil, which are designed to be protective of terrestrial ecosystems, including plants, and which could also be used as a source of TRVs for the BERA.

Response: As suggested, the above-mentioned references will be used as additional sources of TRVs for terrestrial vegetation. The text will be revised accordingly.

15. **Section 6.3.6.3, soil invertebrate exposure assessment and risk characterization, p. 6-65.** The bullet beginning "The barium HQ (1.3)" should be revised as follows. "The barium HQ (1.3) at the RDM site was marginally greater than 1. The next sentence should be deleted in its entirety, as it is a risk management conclusion as discussed in more detail in Specific Comment 14.

    Response: The bullet will be revised as requested.

16. **Section 6.3.6.3, soil invertebrate exposure assessment and risk characterization, p. 6-65.** Many of the TRV sources identified in Specific Comment 15 and General Comment 2 are also applicable for identifying possible TRVs for those chemicals the BERA identifies as lacking baseline TRVs.

    Response: As suggested, the references mentioned in General Comment 2 and Specific Comment 14 will be used as additional sources of TRVs for soil invertebrates.

17. **Section 6.3.6.4, benthic macroinvertebrate exposure assessment and risk characterization, p. 6-65.** Is there a reason the measured benthic invertebrate tissue concentrations were not compared to aquatic biota tissue TRVs such as those published in Dyer et al. 2000 (Environmental Science and Technology 34:2518-2524)? This comparison would provide an additional line of evidence for ecological risks to benthic macroinvertebrates.

    Response: As per the final Risk Assessment Work Plan (RAWP) and draft BERA, two measures were selected to evaluate potential risks to the benthic macroinvertebrate community at the site: (1) comparison of sediment chemical concentrations with

sediment benchmarks and (2) results from benthic macroinvertebrate surveys in Red Devil Creek and nearby reference creeks. As requested, a third measure (comparing benthic macroinvertebrate tissue concentrations with critical tissue concentrations) will be added. Critical tissue concentrations for metals for benthic invertebrates will be developed using an approach described in Dyer et al. (2000) and elsewhere. Specifically, for contaminants of interest, the chronic water quality criterion (WQC) will be multiplied by a bioconcentration factor (BCFs). BCFs will be derived from site-specific data for metals in surface water and benthic macroinvertebrates from Red Devil Creek. Also, E & E will review the materials provided by Burt Shepard (USEPA Region 10) regarding recent work toward developing reliable tissue TRVs for aquatic biota. Approaches and TRVs from these materials will be used as appropriate.

Section 6.3.6.4, benthic macroinvertebrate exposure assessment and risk characterization, p. 6-66. In the section comparing sediment chemical concentrations with sediment screening levels, the bullet beginning with "The HQs for iron (2.4)" needs reworded as follows: "The HQs for iron (2.4), manganese (2.7), and nickel (1.3) slightly exceeded 1." The next sentence must be deleted in its entirety, as it describes a risk management decision that is inappropriate for inclusion in a BERA.

Response: The bullet will be revised as requested.

18. **Section 6.3.6.4, benthic macroinvertebrate exposure assessment and risk characterization, p. 6-66.** The listing of barium, beryllium, methylmercury, thallium and vanadium in sediment as chemicals without TRVs is another example of the lack of effort to identify baseline TRVs within the BERA. Sediment benchmarks for several of these chemicals can be found in the following document: MacDonald, D.D. et al. 1999. A Compendium of Environmental Quality Benchmarks. Prepared for Environment Canada, which can be downloaded from the following website: www.rcaro.org/attach/filedownloads/do_down/no/10049 . One possible additional method of identifying sediment TRVs is to use marine benchmarks as opposed to freshwater benchmarks. There is little evidence to indicate that marine and freshwater species differ in their overall sensitivity to contaminants.

    Response: As suggested, the above-mentioned reference will be used as an additional source of TRVs for benthic macroinvertebrates.

19. **Section 6.3.6.4, benthic macroinvertebrate exposure assessment and risk characterization, p. 6-66.** The benthic macroinvertebrate tissue data in Table 6-42 can also be screened against the tissue TRVs in Dyer et al. 2000 (see Specific Comment 18) as an additional line of evidence within this assessment endpoint.

    Response: See response to Specific Comment 17.

20. **Red Devil Creek Benthic Macroinvertebrate Survey, p. 6-66 and 6-67**. EPA cannot review the draft benthic survey report, leading to the question whether its conclusions should be included in the BERA. EPA would prefer that the benthic survey report be made available for review, even if it is only in draft form, before making a final decision regarding whether its conclusions should be included in the BERA.

    Response: If available at the time the BERA is finalized, the draft benthic survey report will be referenced or attached as an appendix to the BERA. If not, then E & E will discuss with BLM the possibility of including summary tables and figures from the draft benthic survey report in the final BERA.

21. **Section 6.3.6.5, Fish and other aquatic biota exposure assessment and risk characterization, p. 6-67**. First bullet on the page, clarify what medium has HQ values for antimony, arsenic, barium, iron, manganese and mercury exceeding 1. Surface water? Sediment? Fish tissue?

    Response: The statement applies to surface water. The text will be clarified.

22. **Section 6.3.6.5, Fish and other aquatic biota exposure assessment and risk characterization, p. 6-67**. The exposure point concentration discussion of whether or not fish are exposed to water seeping out of a spring whose outflow was several feet above the water level of Red Devil Creek when sampling occurred should be addressed in the problem formulation and conceptual site model development phase of the BERA, not in risk characterization. Without firsthand knowledge of the site, and specifically the variation in surface water elevation in Red Devil Creek that may at times be high enough where the spring flows directly into the creek, we cannot make a definitive statement as to the best way to handle this issue. We recommend that the spring samples be included in the exposure point concentration calculations, with an expanded discussion of whether or not fish are exposed to full strength spring water moved into the uncertainty section of the BERA.

    Response: As suggested, an expanded discussion of whether fish and other aquatic biota in Red Devil Creek are exposed to full strength spring water will be added to the uncertainty section.

23. **Section 6.3.6.5, Fish and other aquatic biota exposure assessment and risk characterization, p. 6-67**. The discussion of the uncertainties surrounding the barium in surface water hazard quotient should be moved to the uncertainty section.

    Response: The discussion will be moved to the uncertainty section.

24. **Section 6.3.6.5, Fish and other aquatic biota exposure assessment and risk characterization, p. 6-67 and 6-68**. EPA recognizes that the 0.012 µg/L chronic

mercury aquatic life criterion is a final residue value, and as such, does not directly reflect what is known about mercury toxicity to aquatic life. Aside from the fact that the chronic value may be considered an ARAR, it is also consistent with more recent evaluations of mercury concentrations which, if not exceeded, are protective of aquatic life. As one example, the current Canadian freshwater quality guidelines for inorganic mercury (0.026 µg/L) and methylmercury (0.004 µg/L) bracket the EPA 0.012 µg/L criteria. The Canadian values are based solely on mercury toxicity to aquatic life, and were derived using much newer toxicity data than was available when EPA promulgated its 0.012 µg/L criteria. Despite being a final residue value, we believe the 0.012 µg/L mercury criterion is also protective of aquatic life. The mercury in surface and spring water discussion in the text on pages 6-67 and 6-68 should be moved to the uncertainty section, and can be expanded to include more recent evaluations of mercury concentration protective of aquatic life.

Response: The discussion will be moved to the uncertainty section and expanded accordingly.

25. **Section 6.3.6.5, Fish and other aquatic biota exposure assessment and risk characterization, p. 6-68**. The last half of the last sentence in this section, which begins with "however, it seems likely that the actual number . . ." is a risk management discussion inappropriate in a BERA, and must be removed from the BERA.

    Response: The text will be revised as requested.

26. **Section 6.3.6.6, Fish community exposure assessment and risk characterization, p. 6-68**. The discussion of selenium in fish tissue risks should be limited to identified risks (or lack thereof) in fish. Any such risks should be identified in the BERA. As noted in other comments, the comparison to background concentrations should be performed at the end of the risk characterization after all risks have been quantified. EPA national policy, as well as the requirements of CERCLA, establish that under CERCLA, cleanup levels are not set at concentrations below naturally occurring background for chemicals such as metals found in naturally occurring concentrations, even if those concentrations are found to pose a level of ecological risk. Chemicals whose BERA exposure point concentrations in the various media are at or below background should be identified in a table at the end of the risk characterization section of the BERA, not discussed in scattered sections throughout the BERA. Selenium risks in tissues can be screened by comparing measured tissue residues to screening level tissue benchmarks in Dyer et al. 2000 (0.57 mg/kg wet weight, the 0.56 mg/kg value in Dyer is a typographical error), followed by the comparison of tissue residues to the EPA draft selenium fish tissue criterion of 7.91 mg/kg dry weight (= 1.58 mg/kg wet weight assuming an 80% water content of fish tissue) in the BERA. All fish tissue discussions and tables should be clarified by stating whether the concentration units are wet weight or dry weight.

Response: As suggested, chemicals whose BERA exposure point concentrations in various media are at or below background will be identified in a table at the end of the risk characterization section of the BERA and discussed there. Selenium risks to fish were evaluated by comparing the selenium concentration in sculpin whole-body samples with a tissue screening benchmark for selenium from Dyer et al. (2000) (see draft BERA Table 6-40 and Section 6.3.6.6). Sixteen of 20 sculpin whole-body samples exceeded the benchmark and therefore selenium was identified as a chemical of concern in fish tissue. We will add the EPA draft selenium fish tissue criterion of 7.91 mg/kg dry weight (1.58 mg/kg wet weight assuming an 80% water content of fish tissue) to the BERA as requested. The newer EPA selenium tissue criterion will be given more weight than the older value from Dyer et al. (2000) when drawing conclusions about potential risks to fish from selenium. All fish tissue discussions and tables will be clarified by stating whether the concentration units are wet or dry weight.

27. **Section 6.3.6.6, Fish community exposure assessment and risk characterization, p. 6-68**. Is there a reason fish tissue concentrations have not been screened against published aquatic biota TRVs (e.g. Dyer et al. 2000, Beckvar et al. 2005, Dillon et al. 2010). The last two papers cited focus largely on mercury ecological risks from their bioaccumulation in fish tissue. Such a screening would provide another line of evidence to evaluate risks to fish communities.

    Response: Fish tissue (sculpin whole body) chemical concentrations were compared with published fish tissue TRVs from Dyer et al. (2000) and other sources in the draft BERA (see draft BERA Table 6-40 and Section 6.3.6.6). This line of evidence was added to the BERA based on a comment from USEPA on the SLERA. See also response to Comment 17 and 26.

28. **Section 6.3.6.6, Fish community exposure assessment and risk characterization, p. 6-68**. Information to identify fish tissue residues of antimony, barium, manganese and vanadium associated with adverse ecological effects of bioaccumulated chemicals may be found in the Environmental Residue Effects Database (ERED), found online at: http://el.erdc.usace.army.mil/ered/. ERED contains residue-effects information for salmonids for barium, manganese and vanadium that could be used to evaluate measured chemical residues in fish from the vicinity of Red Devil Mine. We are aware of only one study of antimony residues in fish eliciting toxicity, a study by Doe et al. 1987 and can be provided upon request. This study can be used to derive a lethal body burden of 9 mg/kg wet weight antimony for rainbow trout.

    Response: ERED will be used as a source of information for fish residue-effects concentrations for barium, manganese and vanadium. As suggested, Doe et al. (1987) will be consulted for information on antimony. A full citation for Doe et al. (1987) would be appreciated.

29. **Section 6.3.6.7.1, Wildlife exposure calculations, p. 6-70 to 6-72.** The wildlife exposure assessment and risk characterization uses standard and acceptable approaches. One question arose during review that we could not evaluate given the information in the BERA. Specifically, pages 6-70 and 6-71discuss the use of both wet weight and dry weight chemical concentrations in food items, where the wet or dry food ingestion rates are species specific. The procedures used in the BERA, which follow the wildlife dietary exposure protocol of Sample et al. 1997, clearly state that dry weight food ingestion rates must be converted to wet weight food ingestion rates before they can be used to calculate dietary exposure to contaminants. We cannot tell from information in the BERA whether the species for which dry weight food ingestion rates were identified were converted to wet weight food ingestion rates before calculating the estimated exposure from diet. This section needs clarification before the results of the risk characterization can be confirmed.

Response: For the common snipe, kingfisher, and mink, the wet food chemical concentration was multiplied by a wet food ingestion rate to calculate exposure from diet. For the other wildlife receptors evaluated in the BERA, dietary exposure was calculated by multiplying the dry food chemical concentration by a dry food ingestion rate. Alternatively for these receptors, the dry food concentration and dry food ingestion rate could be converted to a wet food concentration and wet food ingestion rate using the food water content; however, the two approaches are mathematically equivalent, as shown by the following example calculations for the American robin.

The following exposure parameters for the robin from draft BERA Table 6-44 were used:

Dry food ingestion rate (IR_{dry}) = 0.0186 kg/day
Wet food ingestion rate (IR_{wet}) = 0.093 kg/day (80% food moisture content assumed)
Body weight (BW) = 0.077 kg
Exposure duration (ED) = 0.33
Site Use Factor (SUF) = 1

The modeled arsenic concentration in earthworms (draft BERA Table 6-46) was used:

Dry earthworm concentration ($C_{w,\ dry}$) = 78 mg/kg
Wet earthworm concentration ($C_{w,\ wet}$) = 15.6 mg/kg (80% food moisture content assumed)

Example Calculation 1: Estimated dietary exposure (EE_{diet}) for American robin for arsenic based on dry food concentration and dry food ingestion rate.

$EE_{diet} = (C_{w,\ dry} \times IR_{dry} \times ED \times SUF) / BW = (78 \times 0.0186 \times 0.33 \times 1) / 0.077 = 6.2$ mg/kg/day

Example Calculation 2: EE_{diet} for American robin for arsenic based on wet food concentration and wet food ingestion rate.

$EE_{diet} = (C_{w,\ wet} \times IR_{wet} \times ED \times SUF) / BW = (15.6 \times 0.093 \times 0.33 \times 1) / 0.077 = 6.2$ mg/kg/day

The estimated exposure from diet is 6.2 mg/kg/day using either approach. The text on pages 6-70 to 6-72 will be clarified. We understand that USEPA presently is evaluating the above response and may request revisions to the BERA based on this comment.

30. **Section 6.3.6.7.3, Wildlife risk characterization, risk calculation methodology, p. 6-72 and 6-73.** The discussion in the first paragraph on p. 6-73 borders on being an inappropriate risk management discussion. The paragraph should be reworded to eliminate the "especially if the HQ-NOAEL is only marginally above 1" phrase. It would be acceptable to add a sentence describing why an HQ > 1 does not necessarily imply adverse effects, by pointing out issues such as differing species sensitivity to contaminants between species, intraspecies variability, or other factors that should be discussed in detail in the uncertainty section, to where the reader should be pointed to read the more detailed discussion of this topic. Also, after the chronic adverse effects discussion, add the modifier "to survival, reproduction and/or growth to more clearly tie the potential chronic adverse effects to the assessment endpoints and risk questions of the BERA.

    Response: The paragraph will be revised as recommended.

31. **Section 6.3.6.7.3, Wildlife risk characterization, risk results, p. 6-73.** Instead of describing lead risks as an anomaly, or due to a single sample, the fact that one location of elevated lead concentrations of 3090 mg/kg in soil is driving lead risks should be discussed in terms of a hot spot or localized area of elevated ecological risks. The third bullet in this section, discussing masked shrew risks, is particularly problematic in its wording. The sentence saying risks from selenium and thallium are highly unlikely should be reworded to eliminate this risk management conclusion. Instead, it should be reworded to describe the limited spatial extent of selenium and thallium risks. Similarly, the shrew risks from lead as an anomaly text should be reworded to state that lead risks are primarily due to the elevated soil lead concentration at one station (10MP48SS), not that they are due to an anomaly.

    Response: The text will be revised as requested.

32. **Section 6.3.6.7.3, Wildlife risk characterization, risk results, p. 6-74.** First bullet on page regarding common snipe risks, the last sentence regarding comparison to background needs to be moved to the end of the risk characterization section, where all background comparisons for chemicals identified as posing unacceptable risks should be discussed.

    Response: The text will be revised as requested.

33. **Section 6.3.6.7.3, Wildlife risk characterization, risk results, p. 6-74.** Third bullet on page regarding belted kingfisher risks, the last sentence regarding comparison to

background needs to be moved to the end of the risk characterization section, where all background comparisons for chemicals identified as posing unacceptable risks should be discussed.

Response: The text will be revised as requested.

34. **Section 6.3.7, Uncertainties – Bioavailability, p. 6-7**4. Several comments on this paragraph. First, it should not be implied that contaminants in non-mobile sediments have limited bioavailability – sediment and soil mobility and bioavailability are not related parameters. At least for benthic invertebrates and sculpins in aquatic systems, and terrestrial plants, co-located sediment or soil samples with tissue analyses produce biota sediment (or soil) accumulation factors, or BSAFs, which give a measure of contaminant bioavailability at a location. These estimates of bioavailability warrant discussion in the BERA exposure assessment if they are not discussed elsewhere in the RI report.

    Response: The use of the word "mobile" in this paragraph was an oversight. The term "soluble" should have been used. Adsorption of metals by organisms involves mostly soluble metal species (McGeer et al. 2004). For plants, transfer takes place primarily from a water solution phase. We agree that site-specific media-to-biota bioaccumulation factors warrant discussion in the BERA.

    Reference

    McGeer, J., G. Henningsen, G., R. Lanno, N. Fisher, K. Sappington, and J. Drexler. 2004. *Issue Paper on the Bioavailability and Bioaccumulation of Metals.* Prepared for USEPA Risk Assessment Forum, Washington, D.C, by Eastern Research Group, Lexington, MA.

35. **Section 6.3.7, Uncertainties – Reliability of sediment screening levels, p. 6-7**5. Second sentence in this bullet should be amended to read ". . . conservative predictors of adverse effects for most benthic organisms . . ."

    Response: The text will be revised as requested.

36. **Section 6.3.7, Uncertainties – Reliability of surface water criteria, p. 6-7**6. Specific Comment 26 addresses some of the concerns regarding uncertainties surrounding use of the 0.012 µg/L mercury criterion. It should be noted in this uncertainty section that nearly all mercury in fish tissue is in the form of methylmercury, a chemical form readily bioaccumulated from water and diet. Specific Comment 26 also pointed out that 0.012 µg/L is comparable to the Canadian water quality guideline for inorganic mercury of 0.026 µg/L. EPA does not concur with this portion of the uncertainty section that the 0.012 µg/L criterion is "highly conservative", and believes the highly conservative language should be stricken from the text.

Response: The bullet will be revised in light of the new Canadian water quality guidelines for mercury and methylmercury. See also response to Specific Comment 24.

37. **Section 6.3.7, Uncertainties that underestimate ecological risks.** There is no discussion in the uncertainty section of those uncertainties that primarily or fully serve to underestimate risks. One such uncertainty is the biased sampling design for soils. While EPA agrees it is more likely that such sampling tends to overestimate exposure concentrations, and thus risks, this outcome is by no means assured. It is also possible that areas containing higher contaminant concentrations were not sampled, which would lead to an underestimate of exposure concentrations and risks. This is an example of an uncertainty that can lead to either over- or underestimation of risks, and should be described as such. A much larger omission from the uncertainty section is any meaningful discussion of the large number of chemicals without screening levels, and thus which were not quantitatively evaluated in the BERA. This results in underestimation of risks. Although there is an uncertainty bullet on p. 6-75 that acknowledges that some chemicals do not have TRVs, the text does not state that this absence of TRVs results in underestimation of risks. This omission must be rectified in the uncertainty section. EPA has made numerous comments regarding the lack of a toxicity assessment in the BERA, as well as recommending sources of TRVs which would serve to reduce and minimize the number of chemicals in the BERA lacking TRVs. These sources and others should be reviewed, appropriate TRVs developed, and risks calculated for those chemicals currently without TRVs. EPA recognizes that it is often the case that TRVs cannot be identified for one or more COPCs carried forward into a BERA. But the number of chemicals without TRVs in the Red Devil Mine BERA is unacceptably high given the number of potential sources of ecological TRVs.

    Response: As requested, sources of uncertainty that may lead to an underestimation of risk (e.g., chemicals without TRVs) will be acknowledged in the uncertainty section. As requested in this comment and in Specific Comments 9, 14, and 19, the publications and websites identified by USEPA will be used as sources of additional ecological TRVs for the BERA.

38. **Section 6.3.8, Risk Summary**. This section should be amended to identify all of the media-receptor categories where ecological risks were identified, but which can be demonstrated as due to background chemical concentrations. A table of such categories would be useful to risk managers to ensure that chemicals at or below background but which were found to pose unacceptable risks in the BERA are not used as a basis for site remediation. Any text in this section that states something along the lines that chemicals are likely not COCs because of the low magnitude of risk, low number of samples posing risk, or that risks are due to background concentrations needs to be removed from this section. The chemicals posing risks due to background concentrations are summarized at the end of Section 6.3.8, as discussed in Specific Comment 39.

Response: As requested, the summary will be amended to identify all of the media-receptor categories where ecological risks were identified, but which can be demonstrated as due to background chemical concentrations. Statements that may be interpreted as risk management statements will be removed from the uncertainty section.

39. **Section 6.4.2, Preliminary ecological risk based cleanup levels, p. 6-81**. This section will need to be revisited and reassessed after the additional TRVs called for for chemicals currently without TRVs throughout this review are defined, and ecological risks calculated.

    Response: The section will be updated accordingly to reflect new TRVs added to the BERA.