Technical Assistance Services *for* Communities

Tar Creek Superfund Site, Operable Unit 5

Review of Tar Creek Superfund Site Operable Unit 5 Human Health Preliminary Remediation Goals (PRGs) (Updated)

The community group Local Environmental Action Demanded (L.E.A.D.) Agency asked for assistance from the U.S. Environmental Protection Agency's (EPA's) Technical Assistance Services for Communities (TASC) program. The request was for TASC review and comment on Version 1.1 of the Technical Memorandum: Development of Human Health Risk-Based Preliminary Remediation Goals for Operable Unit 5. TASC prepared a fact sheet summary with comments on Version 1.1 and submitted it to the L.E.A.D. Agency on March 9, 2021. TASC also provided a virtual presentation to the community on Version 1.1 on March 23, 2021.

EPA provided a revised Technical Memorandum (Version 1.2) on June 10, 2021. This fact sheet updates the March 9, 2021, fact sheet to reflect Version 1.2 of the Technical Memorandum. In addition, an addendum to Version 1.2 was provided on June 24, 2021, that describes the methods and results of using an additional PRG development method for lead in sediment that relies on time-weighted average (TWA) assumptions. A description of the addendum is provided at the end of this fact sheet.

EPA asked for comments on Technical Memorandum (Version 1.2) by July 9, 2021. Please email comments to EPA community involvement coordinator Janetta Coats at coats.janetta@epa.gov.

Technical Memorandum Overview

The Technical Memorandum discusses human health risk-based preliminary remediation goals (PRGs) and ecological PRGs. The Technical Memorandum has nine sections and three attachments. The sections are:

1. Site Background
2. Preliminary Remedial Action Objectives
3. Overview of the Basis for Preliminary Remediation Goals
4. Summary of Ecological Preliminary Remediation Goals
5. Summary of Human Health Risk Assessment
6. Human Health Risk-Based PRG Development Approach
7. Uncertainties
8. Findings
9. References

The Technical Memorandum attachments are:

1. Technical Review Workgroup (TRW) Lead Committee Consultation Memorandum (TRW Memo)
2. Sediment and Aquatic Plant Regression Analysis
3. Sensitivity Analysis

Revised text in Version 1.2 of the Technical Memorandum includes changes resulting from comments received from EPA's TRW for metals and asbestos (i.e., the TRW Lead Committee) and tribal stakeholders. Key changes centered on revising the methods used for PRG development. These are summarized briefly below:

- Section 6. Human Health Risk-Based PRG Development Approach: The PRG development methods for tribal lifeway receptors were revised to apply assumptions used in the human health risk assessment. The objective is to develop sediment PRGs protective of human health, not only for direct sediment contact, but also for secondary exposure through direct contact of associated surface water and through aquatic food consumption. Two additional exposure scenarios for general public receptors were developed to present a range of lead PRG options. The PRGs for cadmium and zinc remain largely unchanged.

- Section 7. Uncertainties: The major sources of the uncertainties associated with the PRG development methods and assumptions are described in Section 7. Technical Memorandum Version 1.2 includes additional uncertainty discussions on protectiveness of the calculated sediment PRGs to address secondary exposure through surface water and biota consumption.

- Section 8. Findings: This section summarizes the PRGs. Technical Memorandum Version 1.2 includes more PRGs for general public scenarios compared to Version 1.1. The PRGs for cadmium and zinc did not change largely between the two versions.

This fact sheet covers the first eight sections of the Technical Memorandum. TASC comments follow the summary.

EPA's TASC program funded this fact sheet. Its contents do not necessarily reflect the policies, actions or positions of EPA.

1. Site Background

This section provides background information on the Tar Creek Superfund site and OU5. The site is located in the Tri-State Mining District (TSMD), a former lead and zinc mining area that includes parts of southwest Missouri, southeast Kansas and northeast Oklahoma. OU5 is the sediments and surface water in continuously-flowing creeks, streams and rivers that may be affected by historical mining activities within the Oklahoma part of the TSMD and upstream parts in Kansas and Missouri. EPA further refined the definition of OU5 as part of its OU5 remedial investigation to focus on seven watersheds (areas that drain into creeks, streams and rivers) that flow downstream from Kansas and Missouri into Oklahoma (Figure 1). These include:

- Fourmile Creek (a reference or background area unaffected by historical mining)
- Elm Creek
- Tar Creek (including Lytle Creek)
- Neosho River
- Beaver Creek
- Lost Creek
- Lower Spring River (downstream of Empire Lake in Kansas)

2. Preliminary Remedial Action Objectives

This section describes preliminary remedial action objectives identified in the remedial investigation report and in the advanced screening-level ecological risk assessment. Remedial action objectives are medium-specific or OU-specific goals for protecting human health and the environment. They are used to develop cleanup alternatives. Media in OU5 are surface water, sediment, and aquatic plant and animal tissues. Preliminary remedial action objectives are:

Human Health

- Minimize or prevent human contact with elevated concentrations of metals in OU5 sediment and surface water that may pose an unacceptable risk.
- Minimize or prevent human exposures to elevated concentrations of metals found in OU5 aquatic (water) plants and animals that may pose an unacceptable risk.

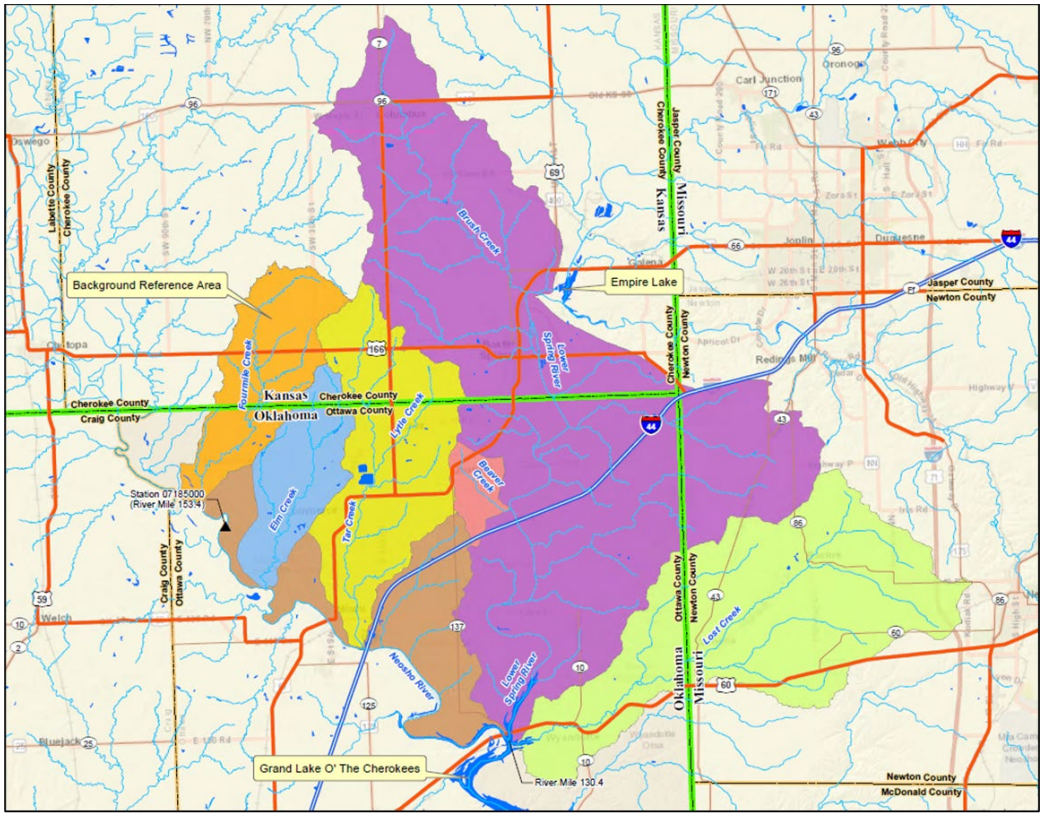

Figure 1. OU5 Study Area Watersheds (adapted from Figure 1-2 of the OU5 Remedial Investigation Report)

Ecological

- Minimize or prevent aquatic plant and animal exposures to sediments and/or porewater (water between particles of sediment) that are sufficiently contaminated to pose moderate or high risk, particularly for fish species that spawn in sediment.
- Minimize risks to sediment-probing birds or plant- and animal-eating mammals that may ingest sediments during feeding activities.

3. Overview of the Basis for Preliminary Remediation Goals

This section presents the basis for EPA's PRGs developed to meet EPA's remedial action objectives. PRGs are used in EPA's feasibility study to define the extent of contaminated media (surface water, sediment, and aquatic plant and animal tissues) requiring remedial action. PRGs are media-specific concentrations of chemicals of concern that are not expected to pose unacceptable risks to human health and the environment. PRGs for OU5 sediment were developed considering:

- Chemical concentrations associated with a noncancer hazard index of 1. (A hazard index of 1 means there is little or no risk of a noncancer health effect.)
- A 5% chance of exceeding a target blood lead level of 5, 8 and 10 micrograms per deciliter (µg/dL).
- Toxicity thresholds indicating a significant ecological risk.
- Background concentrations.

PRGs are also developed considering "applicable or relevant and appropriate requirements" (ARARs), which are federal, state or local regulations. No sediment ARARs are available. EPA will consider surface water ARARs in the feasibility study.

Feasibility Study

EPA's process for developing, screening and evaluating alternative remedial actions

4. Summary of Ecological Preliminary Remediation Goals

This section presents a summary of the ecological risk-based PRGs for sediment, which are risk-based concentrations that correspond to a 10% reduction in animal survival or a 10% reduction in plant biomass (noted as T10 in the Technical Memorandum). If sediment contaminant levels achieve these T10 values, it would reduce current toxicity from about 80% to less than 10%. The Technical Memorandum lists values for the three chemicals of concern, which are the metals cadmium, lead and zinc:

- Cadmium (Cd) – 11.1 milligrams per kilogram of dry weight sediment (mg/kg)
- Lead (Pb) – 150 mg/kg
- Zinc (Zn) – 2,083 mg/kg

The Technical Memorandum also presents a multi-metal risk-based concentration based on the sum of probable effect concentration quotients (PEC-Qs) for each of the three metals:

- $\Sigma PEC\text{-}Q_{Cd,\ Pb,\ Zn}$ – <6.47

The PEC-Q is the ratio of the concentration of a chemical in sediment over the concentration that would probably cause damaging effects to organisms in sediment. If the PEC-Q were less than 1 for each metal, then there would be little risk of harm from that metal. This PRG sets the sum of the three ratios, the PEC-Qs, to be less than 6.47.

5. Summary of Human Health Risk Assessment

This section summarizes the human health risk assessment. The human health risk assessment looked at possible exposures to sediment, surface water, mine discharge, and aquatic plants and animals. Groups evaluated were:

- Tribal Lifeway (adults and children)
- Aquatic Workers (fish hatchery or environmental employees)
- General Public (adults and children)

Table 1 of the Technical Memorandum lists the different types of exposures assumed for children of the tribal lifeway and the general public.

Table 2 of the Technical Memorandum lists final chemicals of concern that contribute to unacceptable levels of risk in media (surface water, sediment, and aquatic plant and animal tissues). Unacceptable risks are an excess lifetime cancer risk greater than 1 in 10,000, a noncancer hazard index greater than 1 for any target organ, and a 5% chance of exceeding a target blood lead level of 5 µg/dL. Final chemicals of concern for the tribal lifeway scenario are:

- Sediment – cadmium, lead and zinc
- Surface water – antimony, arsenic, barium, cadmium, cobalt, iron, lead, manganese, nickel and zinc
- Aquatic plant and animal tissue – barium, cadmium, copper, lead, nickel, silver and zinc

Not all the metals listed above are chemicals of concern for every watershed. Tar Creek and Elm Creek have the highest number of chemicals of concern. No chemicals of concern in sediment are listed for Neosho River or Lost Creek.

6. Human Health Risk-Based PRG Development Approach

This section explains the development of human health risk-based PRGs for sediment. The objective is to develop PRGs that protect people who are exposed directly to sediment, as well as those exposed by direct contact to surface water and food taken from the affected creeks, streams and rivers. Cadmium, lead and zinc are the main site-related chemicals of concern with regard to human health. They are also the only final chemicals of concern in sediment. Human health PRGs were developed for these three metals. Because the approach used in the exposure analysis of lead is different from that of cadmium and zinc, PRGs were developed using different methods. The development of lead PRGs uses a multimedia exposure model (the IEUBK model) that incorporates exposures to sediment, surface water and aquatic plant and animal tissues

from OU5.[1] The cadmium and zinc PRG development methods are based on direct contact (incidental ingestion and dermal contact) and aquatic plant consumption exposure pathways.

Table 3 of the Technical Memorandum presents a summary of the four exposure scenarios used for lead PRG development. Based on comments received on the Technical Memorandum (Version 1.1), the PRGs presented in Technical Memorandum (Version 1.2) were largely developed using assumptions applied in the OU5 human health risk assessment. There are four lead exposure scenarios evaluated in this document (one tribal lifeway and three general public scenarios). Two of these scenarios were added (General Public Scenarios 1 and 3), to provide a wider range of PRG options. Tables 5 and 6 (a, b and c) summarize the specific exposure assumptions and input values applied to the lead PRG modeling.

Table 4 and Figure 4 of the Technical Memorandum presents four sets of lead PRGs. The PRGs in Table 4 range up to 609 mg/kg of lead in sediment. Calculated values depend on whether OU5 surface water is assumed as drinking water, assumptions about lead intake through food consumption from OU5, assumptions about the amount of sediment and surface water that is ingested, and the target blood lead level.

Figure 4 of the Technical Memorandum shows the background threshold level of lead in sediment is 58 mg/kg. The background threshold values represent the background level of a chemical, as established using statistical procedures on the data collected from the background reference area. The background reference area is Fourmile Creek.

Cadmium and zinc were identified as final sediment chemicals of concern for the tribal lifeway. Cadmium was also identified as a final sediment chemical of concern for aquatic workers. Cadmium and zinc in sediment do not present an unacceptable risk to the general public. Table 7 of the Technical Memorandum summarizes the exposure pathways addressed in the cadmium and zinc PRG development. Table 8 shows the assumptions and PRG calculations for tribal lifeway children and aquatic workers. Table 9 lists the cadmium and zinc PRGs for the different human health exposure scenarios, as well as two ecological PRGs – one for 10% reduction (T10) and one for 20% reduction (T20) in animal survival or plant biomass. Human health PRGs for cadmium and zinc were calculated for two scenarios, including one for tribal lifeway children and one for aquatic workers (cadmium only). The calculated human health PRGs for cadmium and zinc are:

- Cadmium: 13.2 mg/kg (tribal lifeway) and 214 mg/kg (aquatic worker).
- Zinc: 2,095 mg/kg (tribal lifeway) (zinc is not a chemical of concern to aquatic workers so it was not evaluated for aquatic worker PRG development).

Figure 5 of the Technical Memorandum shows the background threshold level for cadmium as 0.70 mg/kg and for zinc as 534 mg/kg. It also shows the human health PRG calculated for each scenario. All the human health cadmium and zinc PRGs are higher than the ecological PRGs for 10% animal survival or reduction in plant biomass shown in Section 4.

7. Uncertainties

This section discusses the uncertainties in developing the sediment PRGs. There is uncertainty in methodologies, assumptions and toxicity information. The major sources of the uncertainties associated with the PRGs are:

- Limitation of the biokinetic model used for the lead PRGs.
- Development of the tribal lifeway scenario lead PRG using reasonable maximum exposure assumptions. (Please note: as

[1] The Integrated Exposure Uptake and Biokinetic (IEUBK) model is a computer program used by EPA to predict blood lead concentrations for children who are exposed to lead in water, soil, food, and air in areas where children live and play. For more information see: https://www.epa.gov/superfund/lead-superfund-sites-frequent-questions-general-public#ieubk

emphasized in the Technical Memorandum, the assumed sediment ingestion rate is one of the most important factors for the PRG development. The TRW Lead Committee states "the selected ingestion rate of 400 mg/day for sediment seems very high compared to what is typically used for children (generally 100 mg/day or less)."

- Assumptions used to predict the media transfer of COCs (secondary exposure through surface water and biota consumption).

8. Findings

This section summarizes the results of the revised PRG development, the uncertainties involved with the methods for the PRG development and the next steps to be taken for use of the PRGs. The human health PRGs for lead range from no PRG value calculated[2] to 609 mg/kg lead in sediment with the most conservative values developed for the tribal lifeway exposure scenario. The ecological (T10) PRG is lower (more stringent) than most of the human health general public PRGs presented with one exception (the General Public Scenario 1 PRG for lead based on a blood lead level of 5 µg/L).

The Technical Memorandum did not recommend any PRG in particular for consideration in the feasibility study. The Technical Memorandum only presents the findings of the revised PRG development. Final proposed OU5 sediment PRGs will be presented in a Proposed Plan for public review and comment.

9. References

This section lists the references used.

Version 1.2 Addendum

EPA provided an addendum that describes an additional scenario (General Public 4) beyond the three described in Version 1.2 for the development of a lead in sediment PRG. The General Public 4 scenario accounts for lead exposure in two areas: (1) exposure to sediment at OU5 using an assumed frequency of visits to OU5 sediment; and (2) exposure to lead-impacted soil at home in a residential yard. Using the PRGs developed for General Public Scenario 3, which uses all IEUBK model default input values, assumes no use of OU5 surface water as drinking water, as the basis, the General Public 4 scenario applies a TWA approach to demonstrate differences in using the streamlined (General Public Scenario 3) versus the TWA (General Public Scenario 4) approach. The purpose of doing this was to develop a set of lead PRGs that better account for local conditions and the time that the general public would likely be exposed to lead.

The addendum summary of lead PRGs for the General Public Scenario 4 are 487 mg/kg (blood lead level of 5 µg/dL), 2,167 mg/kg (blood lead level of 8 µg/dL), and 3,357 mg/kg (blood lead level of 10 µg/dL), which are less conservative (greater values) than the PRGs developed for the four exposure scenarios presented in Version 1.2 of the Technical Memorandum.

TASC Comments

TASC comments are for L.E.A.D. Agency members and the community to support understanding of the sediment PRGs and to improve communication with EPA. TASC does not provide comments directly to EPA on behalf of the L.E.A.D. Agency or the community. People who live and work near the site are best equipped to share their own concerns.

TASC developed an initial set of comments for Technical Memorandum (Version 1.1). Version 1.2 addressed TASC's original first comment. This is discussed further below.

- In Table 2 of the Technical Memorandum, no chemicals of concern were identified for the sediment in Neosho River and Lost Creek. Only lead in sediment is identified in Lower Spring River. It was not clear in Version 1.1 why there were no chemicals of concern in these drainages. The text within Version 1.2 clearly confirms which

[2] That is, even if the lead concentration in sediment is zero it would not achieve the target BLL, because of the elevated lead intake through exposure to media other than sediment.

contaminants of concern occur in each drainage and watershed. EPA will evaluate final proposed remedial goals and remedial alternatives during the feasibility study. EPA will present a Proposed Plan for public review and comment. The Proposed Plan will include final remediation goals for each chemical of concern and explain how they apply to each drainage and watershed. *Community members may want to follow EPA's progress and submit formal comments during the Proposed Plan public comment period.*

- It is unclear how site cleanup will be staged and whether runoff from mine wastes on surrounding land is expected to significantly affect the long-term success of a sediment cleanup. This may be evaluated during the feasibility study. *Community members may want to ask EPA to discuss how long-term maintenance of sediment PRG levels will be evaluated in the feasibility study.*

  It may be appropriate to set variable PRGs for sediment. Background values could be appropriate for areas where sediment is being washed downstream and deposited as soils due to flood scour. During flooding, OU5 sediments could be deposited along creek shorelines or even on the Grand Lake shoreline. *Community members may want to ask EPA if it can work with interested parties to identify stream reaches that are susceptible to flood scour and to set stream-specific or stream reach-specific PRGs.*

Flood Scour

Flood scour is the erosion of a riverbed or riverbank by fast-flowing floodwater.

- There is substantial uncertainty in the protectiveness built into the model-derived PRG values. There are more contaminants present in sediment from Elm Creek, Tar Creek and Beaver Creek that may affect the potential toxicity of the sediments. Acid mine drainage and runoff could make metals in surface water and sediment more bioavailable. *Community members may want to ask EPA how it will determine if sediment PRGs are suitably conservative to account for these additional sources of possible chemical exposure and toxicity.*

- Lead PRGs were derived using multiple exposure pathways and exposure setting assumptions. Initial review of Version 1.1 indicated that cadmium and zinc PRGs focused on a subset of these pathways and excluded the pathway of surface water ingestion. The revised Version 1.2 clearly describes how OU5 surface water is not a source of drinking water, therefore only incidental ingestion of surface water during hunting, fishing and recreational activities is addressed as part of the PRG development. Furthermore, surface water COCs will be evaluated by comparison to federal, state and local regulations in the feasibility study. As a result of these text clarifications, the initial concerns regarding surface water exposure were largely addressed.

- The ecological-based T10 PRGs are lower (more conservative) than most of the Human Health PRGs presented in the Technical Memorandum. It seems appropriate to conduct a literature-based evaluation of other sediment PRGs from comparable sites to assist EPA in selecting PRGs that are suitably conservative (protective). *Community members may want to ask EPA to compare site-specific PRGs with PRGs from other sites with similar watershed characteristics and exposure concerns.*

- It is not clear if or how ΣPEC-Q could be used as one of the final PRGs. *Community members may want to ask EPA how this PRG will affect cleanup decisions and the levels of cadmium, lead and zinc in sediment*

after remedial action.

- The presented ecological (T10) PRGs are several times greater than background levels for cadmium (16 times), lead (3 times) and zinc (4 times). The Technical Memorandum indicates that these ecological PRGs would also protect human health for cadmium and zinc. In an EPA webinar and discussion about the PRGs on February 23, 2021, it appeared that Quapaw tribal leaders may prefer the sediment PRGs to be the same as background levels. Setting PRGs to be the same as background could be more protective. However, there are likely tradeoffs, such as cost or the amount of time needed for completion of remedial activities. *Community members may want to provide their opinions about this issue to EPA.*

EPA's PRG Technical Memorandum Overview in Brief

EPA developed PRGs to address human health and ecological remedial action objectives previously identified by EPA for OU5.

The ecological PRGs calculated for OU5 sediment are generally lower than the PRGs calculated for human health.

Final proposed OU5 sediment PRGs will be presented in a Proposed Plan for public review and comment.

For More Information, Please Contact:

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EPA asked for comments on the PRGs Technical Memorandum (Version 1.2) by July 9, 2021. Please email comments to Janetta Coats.