



## Memorandum

**From:** Contaminated Site Cleanup Bureau, DEQ

**Date:** 6/14/2021

**Re:** Evaluating Lead in Soil

This memo is an update to the April 2017 and October 2018 Lead Screening Memo.

Lead exposure is evaluated differently than other non-carcinogens. Because a clear threshold for some of the more sensitive effects in humans from exposure to lead has not been identified, the United States Environmental Protection Agency (EPA) has not developed standard estimates representing a dose-response assessment (e.g., reference doses or reference concentrations) for lead (ATSDR, 2020). Rather, exposure to lead is typically evaluated in terms of the increase in blood lead (PbB) concentrations following exposure. EPA has adopted 10 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) as a PbB concentration of concern to protect sensitive populations. This blood lead level of concern is the basis of EPA Regional Screening Levels (RSLs) of 400 and 800 milligram per kilogram ( $\text{mg}/\text{kg}$ ) for a typical residential and commercial/industrial exposure, respectively. The EPA's stated goal for lead is that children have no more than a 5 percent probability of exceeding a PbB concentration of  $10 \mu\text{g}/\text{dL}$ . As such, this level is assumed to also provide protection for adults (EPA, 1998).

In 2012, the Centers for Disease Control (CDC) released an updated reference level for blood lead of  $5 \mu\text{g}/\text{dL}$  (<https://www.cdc.gov/nceh/lead/prevention/blood-lead-levels.htm>). On August 2, 2016, EPA issued memoranda confirming the CDC's findings and indicating certain shifts in its approach to lead. These memoranda are the Recommendations for Assessing Short-Term Exposure Scenarios Involving Lead at Superfund Sites (EPA, 2016a), and the Recommendations for Using Blood Lead Data at Superfund and RCRA Corrective Action Sites (EPA, 2016b). In addition, EPA issued a memo on May 17, 2017 entitled Transmittal Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters (EPA, 2017).

In these documents, EPA has included blood lead endpoints including the  $5 \mu\text{g}/\text{dL}$  CDC reference level. The Montana Department of Environmental Quality (DEQ) considers a  $5 \mu\text{g}/\text{dL}$  PbB endpoint to be protective of human health. Lead concentrations in soil should be evaluated based upon lead concentrations that are not likely to result in more than a 5 percent probability of exceeding a PbB concentration of  $5 \mu\text{g}/\text{dL}$ . The following calculated values should be used for screening and these values or site-specific concentrations based upon bioavailability, property use, and a  $5 \mu\text{g}/\text{dL}$  PbB endpoint should be used as cleanup levels.

For residential exposure, the concern is for an exposed child during ages 0 to 7 years. This evaluation is facilitated through use of the EPA's Integrated Exposure Uptake Biokinetic Model



for Lead in Children (IEUBK) version 2 (EPA, 2021a). Default estimates are used for all measures in IEUBK, note the Montana DEQ target PbB of 5  $\mu\text{g}/\text{dL}$  is a default model value. The soil concentration protective of residential exposure calculated using EPA default exposure assumptions, including a target PbB of 5  $\mu\text{g}/\text{dL}$  is 200 mg/kg. Residential exposure is evaluated on a yard-by-yard basis. EPA's Superfund Lead-Contaminated Residential Sites Handbook (EPA, 2003a) may be consulted for methodology.

When exposures to lead are not continuous and chronic, lead risks are evaluated using methods provided in Assessing Intermittent or Variable Exposures at Lead Sites (EPA, 2003b). This methodology is supplemental to the standard residential or non-residential exposure scenarios, which use the IEUBK and ALM, respectively. Please familiarize yourself with the guidance documents and talk to your DEQ project officer before using the intermittent methodology.

For adult workers exposed to lead, the comparison of PbB levels to the health-protective goal is facilitated through use of the EPA's Adult Lead Methodology (EPA, 2003c, 2017) and Adult Lead Model (ALM). With the ALM, concern is for a fetus that may be carried by an exposed pregnant female, with the assumption that the results apply to both exposed females and males. The ALM calculates 95th percentile blood-lead concentrations by applying a geometric standard deviation to a central tendency estimate (CTE) calculated from the user specified input parameters. The EPA May 17, 2017 memo recommends updates to the mean baseline blood lead concentration and the geometric standard deviation based upon the 2009-2014 NHANES data (EPA, 2017). The soil concentration protective of commercial/industrial exposure calculated using EPA default exposure assumptions, the 2017 updates, and a target PbB of 5  $\mu\text{g}/\text{dL}$  is 923 mg/kg. However, construction workers are also potentially exposed to surface soil and the default soil ingestion rate for this type of exposure is higher than that of the commercial/industrial workers. The soil concentration protective of construction worker exposure calculated using EPA default exposure assumptions, the 2017 updates, and a target PbB of 5  $\mu\text{g}/\text{dL}$  is 696 mg/kg. Therefore, 696 mg/kg should be used for surface and subsurface soil where construction workers are a current or potential receptor.

The lead models may be accessed at: <https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals>. The model outputs for the DEQ default levels are attached.

EPA generally recommends, and DEQ supports, the use of an arithmetic mean of the exposure areas as the exposure point concentration (EPC) for soil lead concentration as the input for either the ALM or the IEUBK Model (EPA, 2003c). In certain exposure areas, there may be reasons to use the 95 upper confidence limit (UCL) on the mean as the EPC (EPA, 2007). Please work with your DEQ project officer to determine the appropriate approach for your site. When comparing site data to model outputs, please use the 95 UCL on the mean as the EPC, as recommended in the state superfund FAQ: What are some of the general assumptions for a site-specific vapor intrusion risk assessment/analysis at an SRS site? located under the "Risk Assessment/Analysis" category at <https://deq.mt.gov/cleanupandrec/Programs/superfundstate>.



Please note lead concentrations should also be evaluated for leaching to groundwater. The Montana-specific background concentration of lead in soils is 29.8 mg/kg, which is well below the concentrations provided here (MDEQ, 2013). Site-specific background may also be considered. In addition, DEQ will consider site-specific bioavailability for lead based upon the EPA's Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment (EPA, 2021b; EPA, 2021c). Site-specific blood lead levels should not be used to adjust cleanup levels (EPA, 2016b). Finally, based upon EPA's Updated Scientific Considerations for Lead in Soil Cleanups (EPA, 2016c), before DEQ can consider the use of adjusted site exposure parameters, approval of The Office of Superfund Remediation and Technology Innovation and the Technical Review Workgroup for Lead is needed for any adjustment of site-specific exposure parameters.

#### References:

Agency for Toxic Substances and Disease Registry (ATSDR), 2020. Toxicological Profile for Lead. U.S. Public Health Service, Atlanta, GA August.

<https://www.atsdr.cdc.gov/toxprofiles/tp13.pdf>

Montana Department of Environmental Quality (DEQ), 2013. Montana Inorganic Background Investigation Report. DEQ, Helena, MT. [Microsoft Word - r13 MDEQ Bkgd Inorganics Report.docx \(mt.gov\)](#)

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2003b. Assessing Intermittent or Variable Exposures at Lead Sites. EPA-540-R-03-008. Office of Solid Waste and Emergency Response, Washington, DC. November. <https://semspub.epa.gov/work/HQ/176288.pdf>

EPA. 2003c. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil. EP A-540-R-03-001. U. S. Environmental Protection Agency. January. <https://semspub.epa.gov/work/HQ/174559.pdf>

EPA, 2007. SHORT SHEET: Estimating the Soil Lead Concentration Term for the Integrated Exposure Uptake Biokinetic (IEUBK) Model. OSWER 9200.1-78 <https://semspub.epa.gov/work/HQ/175344.pdf> accessed 6/10/2021



EPA, 2016a. Memo: Recommendations for Assessing Short-Term Exposure Scenarios Involving Lead at Superfund Sites. OLEM Directive 9285.6-54.

<https://semspub.epa.gov/work/HQ/196831.pdf>

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<https://semspub.epa.gov/work/HQ/100000158.pdf>

EPA, 2016c. Memo: Updated Scientific Considerations for Lead in Soil Cleanups. OLEM Directive 9200.2-167. <https://semspub.epa.gov/work/08/1884174.pdf>

EPA 2017. Memo: Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. OLEM Directive 9285.6-56. <https://semspub.epa.gov/work/HQ/196766.pdf>

EPA, 2021a. EPA IEUBKwin version 1.1 build 11 to IEUBKwin version 2 (May 2021).

<https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals> accessed June, 1, 2021.

EPA, 2021b. Guidance for Sample Collection for In Vitro Bioaccessibility Assay for Arsenic and Lead in Soil and Applications of Relative Bioavailability Data in Human Health Risk Assessment. <https://semspub.epa.gov/work/HQ/100002711.pdf>

EPA, 2021c. Fact Sheet: Lead RBA and IVBA.

<https://semspub.epa.gov/work/HQ/100002717.pdf>



**Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas**  
**U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee**  
**Commercial Industrial Defaults**  
**Version date 9/28/2018**

**EDIT RED CELLS**

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
$PbB_{fetal, 0.95}$	Target PbB in fetus	$\mu\text{g/dL}$	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	$\mu\text{g/dL}$ per $\mu\text{g/day}$	0.4
$GSD_1$	Geometric standard deviation PbB	--	1.8
$PbB_0$	Baseline PbB	$\mu\text{g/dL}$	0.6
$IR_S$	Soil ingestion rate (including soil-derived indoor dust)	$\text{g/day}$	0.050
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	187
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	274
<b>PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB</b>		<b>ppm</b>	<b>923</b>

EF and AT are based upon Montana climate data. (DEQ, June 2016)  
 GSD<sub>1</sub> and PbB<sub>0</sub> are based upon May 17, 2017 OLEM Directive 9285.6-56





**Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas**  
**U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee**  
**Construction Worker Defaults**  
**Version date 9/28/2018**

**EDIT RED CELLS**

Variable	Description of Variable	Units	GSD <sub>i</sub> and PbB <sub>0</sub> from Analysis of NHANES 2009-2014
PbB <sub>fetal, 0.95</sub>	Target PbB in fetus	µg/dL	5
R <sub>fetal/maternal</sub>	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD <sub>i</sub>	Geometric standard deviation PbB	--	1.8
PbB <sub>0</sub>	Baseline PbB	µg/dL	0.6
IR <sub>s</sub>	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
AF <sub>s, d</sub>	Absorption fraction (same for soil and dust)	--	0.120
EF <sub>s, d</sub>	Exposure frequency (same for soil and dust)	days/yr	124
AT <sub>s, d</sub>	Averaging time (same for soil and dust)	days/yr	274
<b>PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB</b>		<b>ppm</b>	<b>696</b>

EF and AT are based upon Montana climate data. (DEQ, June 2016)

GSD<sub>i</sub> and PbB<sub>0</sub> are based upon OLEM Directive 9285.6-56 (EPA, May 2017)

### Find Soil Pb Concentration

Select Age Group for Graph: 0 to 84 months

Parameter Change

Change Cutoff	5	µg/dl
Change GSD (Geometric Standard Deviation)	1.6	
Probability of Exceeding the Cutoff (PC)	5	%

Soil and/or Dust Concentration: 200 PPM

Buttons: Find, Cancel, Help?

Please note: Depending on the values entered, calculating the PRG may take a few moments.

TRW Homepage: <http://www.epa.gov/superfund/health/contaminants/lead/index.htm>