DEQ
Montana Department of Environmental Quality

Memorandum

From: Aimee Reynolds

Date: October 19, 2018

Re: Evaluating Lead in Soil

This memo is an update to the April 2017 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, 2007). Rather, exposure to lead is typically evaluated in terms of the increase in blood lead (PbB) concentrations following exposure. The United States Department of Health and Human Services' Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) have designated, and the EPA has adopted, 10 micrograms per deciliter (µg/dL) as a PbB concentration of concern to protect sensitive populations (e.g., neonates, infants, and children). This blood lead level of concern is the basis of EPA Regional Screening Levels (RSLs) of 400 and 800 mg/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 µg/dL (USEPA, 2013b). As such, this level is assumed to also provide protection for adults.

In 2012, the CDC released an updated reference level for blood lead of 5 µg/dL (https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm). On August 2, 2016, EPA issued three 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), the Recommendations for Using Blood Lead Data at Superfund and RCRA Corrective Action Sites (EPA, 2016b), and the Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters and the Integrated Exposure Uptake Biokinetic Model's Default Maternal Blood Lead Concentration at Birth Variable (EPA, 2016c). 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).

Steve Bullock, Governor I Tom Livers, Director I P.O. Box 200901 I Helena, MT 59620-0901 I (406) 444-2544 I www.deq.mt.gov

In these documents, EPA has included blood lead endpoints including the 5 µg/dL CDC reference level. The Montana Department of Environmental Quality (DEQ) requires that lead concentrations in soil 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 µg/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 µg/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) (EPA, 2012, 2002, 1994). Default estimates are used for the statistical measures of blood lead, including the target 95th percentile blood lead concentration in fetus, fetal/maternal blood-lead ratio (Rfetal/maternal), biokinetic slope factor, geometric standard deviation on the population mean blood lead concentration (GSDi), and baseline blood lead concentration. Default values are also used for exposure parameters such as the lead absorption fraction and the averaging time. EPA's May 17, 2017 memo recommends that the maternal blood lead concentration in the IEUBK model be changed to 0.6 µg/dL based upon National Health and Nutrition Examination Survey (NHANES) data collected between 2009 and 2014 (EPA, 2017). The soil concentration protective of residential exposure calculated using EPA default exposure assumptions, the new NHANES value, and a target PbB of 5 µg/dL is 154 mg/kg. Residential exposure is evaluated on a yard-by-yard basis. EPA's Superfund Lead-Contaminated Residential Sties Handbook (EPA, 2003c) may be consulted for methodology. Undeveloped property with unrestricted future use may require a point-by-point evaluation.

Intermittent exposures are evaluated using methods provided in Assessing Intermittent or Variable Exposures at Lead Sites (EPA, 2003c).

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, 2003a,b,d; 2007a,b; 2009) 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 µg/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 µg/dL is 696 mg/kg. Therefore, 696 mg/kg should be used to determine protectiveness of commercial/industrial exposure areas and should also be used to screen subsurface soil for construction worker exposure. The 95% upper confidence limit

on the mean for the appropriate exposure area is compared to these commercial/industrial concentrations.

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

Please note that lead concentrations must 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 (DEQ, 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, 2007c). Site-specific blood lead levels will not be used to adjust cleanup levels based upon EPA Technical Review Workgroup for Lead guidance (EPA, 2018). Finally, based upon EPA's Updated Scientific Considerations for Lead in Soil Cleanups (EPA, 2016a), DEQ will not consider adjustment of site-specific exposure parameters without The Office of Superfund Remediation and Technology Innovation and the Technical Review Workgroup for Lead approval.

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. *Toxicological Profile for Lead.* U.S. Public Health Service, Atlanta, GA. August.

Montana Department of Environmental Quality (DEQ). 2013. *Montana Inorganic Background Investigation Report.* DEQ, Helena, MT. September.

United States Environmental Protection Agency (EPA). 1994. *Guidance Manual for the IEUBK Model for Lead in Children.* OSWER #9285.7-15-1. Office of Solid Waste and Emergency Response, Washington, DC. February.

EPA. 2002. *Reference Manual: Documentation of Updates for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows® Version – 32-Bit Version.* OSWER 9285.7-44. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Available online at: http://www.epa.gov/superfund/lead/products/rmieubk32.pdf. May.

EPA. 2003a. *Adult Lead Methodology (ALM) Spreadsheet.* Available at: http://www.epa.gov/oswer/riskassessment/tools.htm. EPA-540-R-03-001. OSWER 9285.7-54. U.S. Environmental Protection Agency, Technical Review Workgroup for Lead, Adult Lead Committee. U.S. Environmental Protection Agency. January.

EPA. 2003b. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil.* EPA-540-R-03-001. U.S. Environmental Protection Agency. January.

EPA. 2003c. *Superfund Lead-Contaminated Residential Sites Handbook.* OSWER 9285.7-50. U.S. Environmental Protection Agency. August.

EPA. 2003d. *Human Health Toxicity Values in Superfund Risk Assessments*. From: Michael B. Cook, Director /s/ Office of Superfund Remediation and Technology Innovation, To: Superfund National Policy Managers, Regions 1 - 10. OSWER Directive 9285.7-53. U.S. Environmental Protection Agency. December.

2003e. *Assessing Intermittent or Variable Exposures at Lead Sites*. EPA-540-R-03-008. Office of Solid Waste and Emergency Response, Washington, DC. November.

EPA. 2007a. *System Requirements and Design for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows.* EPA 540-K-01-005. Available online at: http://www.epa.gov/superfund/lead/products/srdieubk32.pdf. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Information. May.

EPA. 2007b. *Frequently Asked Questions from Risk Assessors on the Adult Lead Methodology (ALM).* What is an appropriate soil ingestion rate (IR) for a construction scenario (i.e., soil contact-intensive scenario)? Available online at: http://www.epa.gov/superfund/health/contaminants/lead/almfaq.htm. U.S. Environmental Protection Agency. Accessed on June 16, 2007.

EPA. 2007c. *Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment.* OSWER 9285.7-80. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. May.

EPA. 2009. *Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameter.* OSWER 9200.2-82. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June 2009 – Update to the ALM.

EPA. 2016. *Updated Scientific Consideration for Lead in Soil Cleanups*. Office of Solid Waste and Emergency Response. December.

EPA. 2017. *Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters*. OLEM Directive 9285.6-56. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. May.

EPA. 2018. *Frequent Questions from Risk Assessors on the Integrated Exposure Uptake Biokinetic (IEUBK) Model.* Available online at: http://www.epa.gov/superfund/lead/ieubkfaq.htm. U.S. Environmental Protection Agency. October.

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	µg/dL	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	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
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**923**

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

GSD_i and PbB_0 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	GSDi and PbBo from Analysis of NHANES 2009-2014
$PbB_{fetal,\ 0.95}$	Target PbB in fetus	µg/dL	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.120
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	124
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	274
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**696**

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

GSD_i and PbB_0 are based upon OLEM Directive 9285.6-56 (EPA, May 2017)

IEUBK output using 0.6 µg/dL Maternal Blood Lead per OLEM Directive 9285.6-56 (EPA, May 2017)