

**USER'S GUIDE TO LEADSPREAD 8**  
**AND**  
**RECOMMENDATIONS FOR EVALUATION OF LEAD EXPOSURES IN ADULTS**

**California Department of Toxic Substances Control (DTSC)**

**Human and Ecological Risk Office (HERO)**

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## **DTSC LEAD RISK ASSESSMENT SPREADSHEET (LeadSpread 8)**

**A tool for evaluating exposure and the potential for adverse health effects resulting from exposure to lead in the environment.**

LeadSpread was created to run on **Microsoft Excel®**

1) **Background:** Historically, LeadSpread has been a tool used by DTSC to estimate blood lead concentrations resulting from exposure to lead via dietary intake, drinking water, soil and dust ingestion, inhalation, and dermal contact. In past versions of LeadSpread (through the LeadSpread 7, January 2009 Update), each of these pathways was represented by an equation relating incremental blood lead increase to a concentration in an environmental medium, using contact rates and empirically determined ratios. The contributions via the five pathways were added to arrive at an estimate of median blood lead concentration resulting from the multi-pathway exposure. Ninetieth, ninety-fifth, ninety-eighth, and ninety-ninth percentile concentrations were estimated from the median by assuming a log-normal distribution with a geometric standard deviation (GSD) of 1.6.

In 2007, CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) developed a new toxicity evaluation of lead replacing the 10 µg/dL threshold blood concentration with a source-specific "benchmark change" of 1 µg/dL (OEHHA 2007, [http://oehha.ca.gov/public\\_info/public/kids/pdf/PbHGV041307.pdf](http://oehha.ca.gov/public_info/public/kids/pdf/PbHGV041307.pdf)). One µg/dL is the estimated incremental increase in children's blood lead that would reduce IQ by up to 1 point. In light of the updated CalEPA lead toxicity criterion, as well as the need for revision to ensure that the model is adequately protective of women of child-bearing age, a new version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET (LeadSpread 8; 2011) has been developed.

2) **General Information for DTSC LeadSpread 8:** DTSC LEAD RISK ASSESSMENT SPREADSHEET (LeadSpread 8; 2011) is written in Microsoft Excel. It is designed to be self-contained.

Worksheet 1 (DTSC PB8 [child]) of the Excel spreadsheet is a revision of LeadSpread 7, and should be used for evaluating residential land use scenarios. Worksheet 2 (Modified USEPA ALM [adult]) is a modified version of USEPA's 6/21/09 Adult Lead Model (ALM) which incorporates DTSC recommendations for evaluating industrial worker exposures to lead in soil. Worksheet 2 is not DTSC's LeadSpread model, but has been included as a separate worksheet of the DTSC LeadSpread 8 Excel file for convenience and use in evaluating adult exposures to lead. Please see below for additional information.

The basic equations and majority of default input values in LeadSpread Version 8, Worksheet 1 (DTSC PB8 [child]) are similar to previous versions. Major updates in this 2011 revision of DTSC's LeadSpread model are the following:

- a. The blood lead level of concern was updated to 1 ug/dL (the 2007 Cal/EPA OEHHA benchmark incremental change criterion for lead).
- b. Previous versions of LeadSpread calculated Preliminary Remediation Goals (PRGs) which were the concentrations in exterior soil and interior dust that result in a 95th and 99th percentile estimate of blood lead equal to 10 ug/dL. Because the target PbB level of concern was updated to the more recent health-protective criterion of 1 ug/dL, HERO considers the 90th percentile of the distribution appropriate for use in calculating a lead soil PRG.
- c. LeadSpread 8, Worksheet 1 (DTSC PB8 [child]) evaluates a source-specific exposure to lead in soil assuming the following exposure routes: ingestion, dermal contact, and dust inhalation. Background exposures to lead, and media other than soil/dust which may be impacted by lead are not considered in the model. If lead is present at levels above background in media other than soil (e.g. water, air) or if the home grown produce pathway is anticipated at the site, please contact the HERO toxicologist. DTSC's LeadSpread model is currently undergoing additional revision, and we hope to incorporate additional exposure pathways and environmental media in the near future.
- d. DTSC does not recommend adult exposures to lead be evaluated using the LeadSpread model at this time, and additional revision of the model is planned to ensure it is adequately protective of women of child-bearing age. As a result, LeadSpread 8 Worksheet 1 (DTSC PB8[child]) addresses child exposures only and should be used for evaluating lead exposure under residential land use scenarios.

Worksheet 2 (Modified USEPA ALM [adult]) is a modified version of USEPA's 6/21/2009 Adult Lead Model (ALM) which incorporates DTSC recommendations for evaluating industrial worker exposures to lead in soil. As noted above, Worksheet 2 is not DTSC's LeadSpread model, but has been included as a separate worksheet of the DTSC LeadSpread 8 Excel file for convenience. For detailed information on USEPA's ALM, please consult USEPA guidance (USEPA, 2003, 2009a, 2009b; <http://www.epa.gov/superfund/lead/products.htm>). For alternate land use scenarios where adult exposures to lead are expected, the default assumptions shown in Worksheet 2 may need to be modified. In such cases, justification for any proposed alternate values must be provided. Finally, USEPA's ALM addresses exposure to lead from soil and soil-derived indoor dust based on the ingestion pathway only. Background exposures to lead, and media other than soil which may be impacted by lead are not considered. If lead is present at levels above background in media other than soil (e.g. water, air) or additional pathways are anticipated to be significant at a site, please contact the HERO toxicologist.

3) Specific Information for Worksheets 1 and 2:

a. Documentation. Many of the Worksheet 1 and 2 cells contain notes which explain the cell contents when the cursor is moved over the cell. References are provided in comments attached to Worksheet 1 cell A29 and Worksheet 2 cell A24. For reference, this document does not repeat all information included in the Worksheet 1 and 2 comments. As such, this document should be consulted in conjunction with the Worksheet comments.

b. Worksheet 1 (DTSC PB8 [child]). As noted above, Worksheet 1 (DTSC PB8 [child]) is a revision of LeadSpread 7, and should be used for evaluating lead exposure under residential land use scenarios.

Site-related data are entered in cells B9 and B10 of this worksheet. The default value for respirable dust may be used when site-specific data are not available. Cells C16 through C27 contain exposure parameters which are generally not site-specific. Departure from default values in cells C16 through C27 must be justified. Numerical values in other cells are generally formulas, and although they may be changed for various purposes, any results obtained from the modified spreadsheet should not be represented as having come from the DTSC LEAD RISK ASSESSMENT SPREADSHEET.

The worksheet is protected with the exception of the input cells (B9 and B10) to avoid inadvertent changes in formulas. If you wish to alter exposure parameters or formulas you may use the unprotect feature of Excel to unprotect the sheet. There is no password (the password field should be left blank, and the 'enter' key clicked). If the results will be submitted to DTSC, you will be required to identify and justify any changes other than to the input cells.

c. Worksheet 2 (Modified USEPA ALM [adult]). As detailed above, Worksheet 2 (Modified USEPA ALM [adult]) is a modified version of USEPA's 06/21/2009 Adult Lead Model (ALM) which incorporates DTSC recommendations for evaluating industrial worker exposures to lead in soil.

HERO Modifications to USEPA's ALM were the following:

- USEPA's ALM model was updated to indicate that "Soil lead concentration" is the only cell for which site-specific inputs should be entered. We recommend that any proposed alternate values for "Geometric standard deviation PbB", "Baseline PbB", or "Target PbB level of concern (e.g., 10 ug/dL)" be discussed with the HERO toxicologist.
- Three variables from USEPA's ALM ("Total ingestion rate of outdoor soil and indoor dust", "Weighting factor; fraction of IRS+D ingested as outdoor soil", and "Mass fraction of soil in dust") were deleted for simplicity. The HERO

toxicologist should be contacted if indoor dust and outdoor soil will be evaluated separately.

- The default "Geometric standard deviation PbB" recommended by DTSC for evaluating adult exposures to lead is 1.8. This value is consistent with USEPA's June 2009 recommendation based on their analysis of the NHANES 1999–2004 data (USEPA, 2009b).
- The default "Baseline PbB" recommended by DTSC is 0 ug/dL. Because the target PbB level of concern is a source-specific, incremental change due to soil/dust exposures only (see discussion below), no baseline PbB is assumed in the modified version of USEPA's ALM.
- For industrial workers, DTSC's recommended default exposure frequency is 250 days per year (USEPA, 1991).
- The "95th percentile PbB among fetuses of adult workers" variable was modified to the "90th percentile PbB among fetuses of adult workers." The associated equation in cell F18 was also updated consistent with this change. Because the target PbB level of concern was updated to the more recent health-protective criterion of 1 ug/dL (see below), HERO considers the 90th percentile of the distribution appropriate for use in evaluating lead exposures.
- The "Target PbB level of concern (e.g. 10 ug/dL)" was changed to 1 ug/dL (the 2007 Cal/EPA OEHHA benchmark incremental change criterion for lead). While the 2007 Cal/EPA OEHHA criterion is specific for children, this criterion is applicable to an industrial land use for protection of the fetus of an adult worker exposed to lead in soil.
- The USEPA ALM includes two worksheets: "Calculations of Blood Lead Concentrations (PbBs)" and "Calculations of Preliminary Remediation Goals (PRGs)." For simplicity, HERO has incorporated the PRG calculation presented in USEPA's ALM worksheet two into cells B22 and B23 of LeadSpread 8 Worksheet 2 (Modified USEPA ALM [adult]).

In Worksheet 2 (Modified USEPA ALM [adult]), the PRG calculation was modified to the 90th percentile (rather than 95th percentile). In addition, the "95th percentile PbB in fetus" variable used in USEPA's ALM PRG equation was changed to the "Target PbB level of concern." This change was incorporated because unlike USEPA's ALM Worksheet 2, the "percentile PbB in fetus" is a calculated value (rather than a constant) in the Modified USEPA ALM [adult] Worksheet. Variable defaults used to calculate the "PRG90" are shown on the Worksheet and explained in the cell comments.

When using Worksheet 2 (Modified USEPA ALM [adult]), site-related data are entered in cell F8. Cells F9 through F16 contain exposure parameters and assumptions for an industrial land use scenario which are generally not site-specific. For alternate land use scenarios (other than industrial) where adult exposures to lead are expected, the default Worksheet 2 assumptions may need to be modified. In such cases, justification for any proposed alternate values should be provided.

4) Preliminary Remediation Goals (PRGs) and Use of PRGs for Site Evaluation:

Worksheets 1 and 2 of the LeadSpread 8 file include PRG90 calculations for residential and industrial land use scenarios, respectively. The PRG90s represent concentrations in exterior soil and interior dust that will result in a 90th percentile estimate of blood lead in child or the fetus of a pregnant adult worker equal to 1 ug/dL. While DTSC has historically used the 99<sup>th</sup> percentile estimate of blood lead, HERO considers the 90th percentile of the distribution appropriate for use in evaluating lead exposures given that the target PbB level of concern was updated to the more recent health-protective criterion of 1 ug/dL.

Use of PRG90s is a departure from the previously utilized Cal-modified USEPA Region 9 PRG value of 150 mg/kg for residential land use and 800 mg/kg for industrial land use. HERO implements this risk-based soil concentration as a residential use (i.e., unrestricted use) scenario Exposure Point Concentration (EPC), calculated as the 95 percent upper confidence limit on the arithmetic mean (95% UCL) of 80 mg/kg or less soil lead and an industrial/commercial use 95% UCL of 320 mg/kg or less soil lead. With regard to assessment of lead risk and evaluating cleanup options, if sufficient data are available, HERO recommends calculating the 95% UCL on the arithmetic mean lead concentration for each exposure area. If individual samples exceed the PRG90, it would not mean that the exposure area itself is in exceedance of the PRG90 as long as the 95% UCL itself is below ~80 mg/kg for residential and ~320 mg/kg for industrial/commercial, assuming hot spots are not present. If "hot spots" (i.e., geographically collocated areas of elevated concentration, or "outliers" (i.e., individual samples with elevated concentrations) are present, they must be addressed separately.

For initial site screening where data are insufficient to calculate a 95% UCL, comparison of the maximum detected concentration to the PRG90s would be appropriate. If individual sample results exceed the PRG90s, depending on site-specific conditions and sampling results, additional investigation, evaluation, and potentially remediation may be warranted to address concerns about lead exposure.

## REFERENCES FOR WORKSHEET 1 (DTSC PB8 [CHILD])

1. Agency for Toxic Substances and Disease Registry (ATSDR). 1990. ATSDR, U.S. Public Health Service; Toxicological Profile for Lead.
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**REFERENCES FOR WORKSHEET 2 (MODIFIED USEPA ALM [ADULT])**

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4. US Environmental Protection Agency. 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, OSWER Directive 9285.6-03, Interim Final, March 25, 1991.