



**Montana Risk Assessment Tables**  
Draft User's Guide

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# Section 1

## Introduction

The Montana Department of Environmental Quality (DEQ) has prepared these generic Risk Assessment Guidance for Superfund (RAGS) Part D tables (Montana Risk Assessment Tables) to be part of the evaluation of risks posed by sites potentially requiring remediation in the State of Montana. This document provides guidance on the use of these tables. The Montana Risk Assessment Tables should be used in conjunction with available EPA guidance and DEQ state-specific guidance referenced in DEQ's State Superfund Frequently Asked Questions available on the DEQ web site:

<http://deq.mt.gov/Land/StateSuperfund/FrequentlyAskedQuestions#riskAssessment>.

### 1.1 Overview

The Montana Risk Assessment Tables are based on the United States Environmental Protection Agency's (EPA's) Risk Assessment Guidance for Superfund (RAGS) Part D (EPA, 2001), populated by Montana-specific exposure factors (DEQ, 2016a and 2016b). The tables may be used to evaluate cancer and noncancer health risks potentially experienced by residents, commercial or industrial workers, construction workers, and recreators or trespassers. The tables include parameters related to incidental ingestion and dermal absorption of contaminants in soil and sediment as well as inhalation of dust and vapors in soil. If less common exposure pathways such as plant or breastmilk consumption are relevant, these pathways may be added by the user.

Typically, groundwater and surface water are assessed qualitatively by comparing exposure point concentrations to DEQ-7 standards, Montana Risk-Based Corrective Action Guidance for Petroleum Releases (RBCA) risk-based screening levels (RBSLs), or EPA tapwater Regional Screening Levels (RSLs); therefore, there are groundwater and surface water tables available for screening for the selection of contaminants of concern for groundwater and surface water. For contaminants that do not have DEQ-7 standards, the tables allow for quantitative evaluation of groundwater ingestion as drinking water and incidental ingestion and dermal contact with surface water by recreators.

The tables were developed in a Microsoft Excel® workbook compatible with Microsoft Excel® 2010, 2013, and 2016 (*Montana RAGS Tables.xlsx*). The workbook is meant to be used to evaluate risks from exposure to surface soil, subsurface soil, groundwater, surface water, and sediment within a particular exposure area or unit. Separate workbooks should be used to evaluate risks associated with multiple exposure areas or units. The risk assessment text should explain the information included in the tables.

Table 1 lists the tables included in the Excel® workbook.

### 1.2 Vapor Intrusion

Because of the extreme variability associated with vapor intrusion, DEQ does not use traditional risk assessment methods to calculate numeric risks associated with this pathway or develop site-

specific cleanup levels (SSCLs). Therefore, RAGS tables may be used to screen for selection of contaminants of concern using RSLs or screening levels available in the Montana Air-Phase Petroleum Hydrocarbon calculator located on DEQ's Vapor Intrusion Website:

<http://deq.mt.gov/Land/statesuperfund/viguide>.

Based upon initial screening results, it may be appropriate to develop SSCLs. It is not anticipated that these generic tables will be used for development of vapor intrusion SSCLs. However, the SSCLs should focus only on the compounds present at a particular site, and may be calculated for traditional exposures or for other types of exposures, like those for schools. The equations provided in the EPA's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (EPA, 2009b) and reproduced in the EPA Regional Screening Levels User's Guide (EPA, 2009a) are used to develop SSCLs. SSCLs are based upon all contaminants present in indoor air at the site and not those present in each structure if more than one structure is potentially impacted. General assumptions for vapor intrusion SSCL development are provided on DEQ's Risk Assessment Website at <http://deq.mt.gov/Land/StateSuperfund/FrequentlyAskedQuestions#riskAssessment> and the SSCLs should ensure a cumulative risk of  $1 \times 10^{-5}$  and a cumulative hazard index of 1 for each target organ or critical effect. Because the vapor intrusion evaluation does not follow the steps represented by the RAGS Tables, the vapor intrusion scenario should be evaluated separately.

**Table 1 List of Montana Risk Assessment Tables**

Number	Description
Chemicals	Chemical Lists to Evaluate
Table 1.0	Selection of Exposure Pathways
Table 2.1	Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Surface Soil
Table 2.2	Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Subsurface Soil
Table 2.3	Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Groundwater
Table 2.4	Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Surface Water
Table 2.5	Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Sediment
Table 2.6	Summary Table - Chemicals of Potential Concern
Table 3.1	Exposure Point Concentration Summary – Surface Soil
Table 3.2	Exposure Point Concentration Summary – Subsurface Soil
Table 3.3	Exposure Point Concentration Summary – Groundwater
Table 3.4	Exposure Point Concentration Summary – Surface Water
Table 3.5	Exposure Point Concentration Summary – Sediment
Table 4.1	Values Used for Daily Intake Calculations – Soil
Table 4.2	Values Used for Daily Intake Calculations – Inhalation
Table 4.3	Values Used for Daily Intake Calculations – Groundwater
Table 4.4	Values Used for Daily Intake Calculations – Surface Water
Table 4.5	Values Used for Daily Intake Calculations – Sediment
Table 4.6	Values Used for Chemical Specific Intake Calculations
Table 5.1	Non-Cancer Toxicity Data – Oral/Dermal
Table 5.2	Non-Cancer Toxicity Data – Inhalation
Table 6.1	Cancer Toxicity Data – Oral/Dermal
Table 6.2	Cancer Toxicity Data – Inhalation
Table 7.1	Calculation of Non-Cancer Hazards for Soil – Resident
Table 7.2	Calculation of Chemical Cancer Risks for Soil – Resident
Table 7.3	Calculation of Non-Cancer Hazards for Groundwater – Resident
Table 7.4	Calculation of Chemical Cancer Risks for Groundwater – Resident
Table 7.5	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Commercial/Industrial Worker
Table 7.6	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Construction Worker – Surface Soil
Table 7.7	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Construction Worker – Subsurface Soil
Table 7.8	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Recreator/Trespasser – Soil
Table 7.9	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Recreator/Trespasser – Surface Water
Table 7.10	Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Recreator/Trespasser – Sediment
Table 9.1	Summary of Receptor Non-Cancer Hazards for COPCs in Soil – Resident
Table 9.2	Summary of Receptor Cancer Risks for COPCs in Soil – Resident
Table 9.3	Summary of Receptor Non-Cancer Hazards for COPCs in Groundwater – Resident
Table 9.4	Summary of Receptor Cancer Risks for COPCs in Groundwater – Resident
Table 9.5	Summary of Receptor Risks and Hazards for COPCs – Commercial/Industrial Worker
Table 9.6	Summary of Receptor Risks and Hazards for COPCs – Construction Worker – Surface Soil
Table 9.7	Summary of Receptor Risks and Hazards for COPCs – Construction Worker – Subsurface Soil
Table 9.8	Summary of Receptor Risks and Hazards for COPCs – Recreator/Trespasser – Soil
Table 9.9	Summary of Receptor Risks and Hazards for COPCs – Recreator/Trespasser – Surface Water
Table 9.10	Summary of Receptor Risks and Hazards for COPCs – Recreator/Trespasser – Sediment

Number	Description
Summary Table 1	Summary of Risk Characterization Results - Resident - Non-Cancer Hazards – Soil
Summary Table 2	Summary of Risk Characterization Results - Resident - Cancer Risks – Soil
Summary Table 3	Summary of Risk Characterization Results - Resident - Non-Cancer Hazards – Groundwater
Summary Table 4	Summary of Risk Characterization Results - Resident - Cancer Risks – Groundwater
Summary Table 5	Summary of Risk Characterization Results - Commercial/Industrial Worker
Summary Table 6	Summary of Risk Characterization Results - Construction Worker - Surface Soil
Summary Table 7	Summary of Risk Characterization Results - Construction Worker - Subsurface Soil
Summary Table 8	Summary of Risk Characterization Results - Recreator/Trespasser – Soil
Summary Table 9	Summary of Risk Characterization Results - Recreator/Trespasser - Surface Water
Summary Table 10	Summary of Risk Characterization Results - Recreator/Trespasser – Sediment

## Section 2

# Guidance for Risk Assessment Tables

To estimate risks associated with a set of exposure points using the Montana Risk Assessment Tables, the user selects the chemicals and media to include in the risk assessment, enters exposure point concentrations for the selected chemicals, enters background concentrations and screening levels for the selected chemicals, reviews exposure parameters used in the calculation of daily intakes, and enters toxicity data for chemicals of concern. Should the user wish to calculate cleanup levels, the user specifies the target risk levels for the chemicals of concern ensuring that the cumulative risk does not exceed  $1 \times 10^{-5}$  or a cumulative hazard index of 1 for each critical effect or target organ. The sections that follow describe the information that is provided by the user.

In using the tables, the user should be aware of the following general guidelines:

- Macros must be enabled within the spreadsheet to allow the tables to perform properly. Disabling macros will disable some of the tables' functionality.
- All soil and sediment concentrations and screening levels should be entered in units of milligrams per kilogram (mg/kg). The calculations are based on these units.
- Similarly, all water concentrations and screening levels should be entered in units of micrograms per liter ( $\mu\text{g/L}$ ).
- Reference doses should be entered in units of milligrams per kilogram-day (mg/kg-d), and reference concentrations in units of milligrams per cubic meter ( $\text{mg/m}^3$ ). Oral cancer slope factors and inhalation unit risks should be entered in units of inverse milligrams per kilogram-day  $(\text{mg/kg-d})^{-1}$  and inverse micrograms per cubic meter  $(\mu\text{g/m}^3)^{-1}$ , respectively.
- Spreadsheet cells shaded in gray should generally not be changed. These cells contain formulas, and overwriting these formulas may lead to incorrect risk assessment results. While these cells should generally not be changed, they are left unprotected to allow the user to easily copy and paste information from these cells and to allow for changes in rare circumstances when changes may be necessary due to site-specific circumstances. If any changes are made to shaded cells, the user should clearly document such changes for DEQ review.
- A few chemicals are intentionally included in the risk assessment tables multiple times. Several polycyclic aromatic hydrocarbons (PAHs), for example, are included both within the semivolatile organic compounds (SVOCs) and also within extractable petroleum hydrocarbons (EPHs). Similarly, benzene, ethylbenzene, toluene, and xylenes (BTEX compounds) appear as both volatile organic compounds (VOCs) and volatile petroleum hydrocarbons (VPHs). This is because concentrations of these chemicals are frequently reported using multiple analytical methods. The user should be aware that some chemicals can appear multiple times in the tables, and the user should ensure that risks associated

with these chemicals are not double-counted. In general, to be conservative, DEQ bases risk decisions on the higher of the two concentrations.

- If the risk assessment tables are modified by the user to add chemicals or additional exposure pathways, caution should be exercised to ensure that the links between cells in the spreadsheet are not affected, resulting in erroneous risk estimates.
- Default notes or footnotes have been added to the bottom of many of the tables. All table notes should be reviewed and updated to reflect information about the specific site under evaluation.
- Some cells and worksheets in the spreadsheet workbook are deliberately hidden. These cells are necessary for the workbook to function properly, but provide no additional information to the user. These hidden cells should not be altered.

## 2.1 Initial Setup

The site name and location are specified on the *Contents* worksheet of the Excel® workbook.

Specify the site name in the top left cell (cell A1) of the *Contents* worksheet. Specify the location (city or county within Montana) immediately below (cell A2). The site name and location will propagate through all tables of the workbook.

Chemicals of potential concern (COPCs) to be included in the risk assessment are specified on the *Chemicals* worksheet.

Several groups of chemicals can be selected to include in the risk assessment tables:

- Volatile Organic Compounds
- Semivolatile Organic Compounds
- Metals<sup>1</sup>
- Volatile Petroleum Hydrocarbons
- Extractable Petroleum Hydrocarbons
- Polychlorinated Biphenyls
- Dioxins and Furans
- Chlorinated Herbicides
- Organochlorine Pesticides

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<sup>1</sup> Lead is included in the list of metals. If selected, lead concentrations can be compared to screening levels in the tables. Lead, however, is a developmental toxin that cannot be quantitatively evaluated using the methods incorporated in the Montana Risk Assessment Tables. If lead concentrations exceed screening levels, potential health effects associated with lead should be evaluated by a risk assessor.

- Others

Individual chemicals included in each group are listed in Appendix A.

To select all chemicals within a group for all media (surface soil, subsurface soil, groundwater, surface water, and sediment), select the *Show All* button next to that group. To exclude all chemicals, select the *Hide All* button. To select only certain chemicals or media within a chemical group, select the *Show Selected* button then click the button immediately to its right to open a dialog box allowing the user to select specific chemicals and media to include in the risk assessment. Only chemicals detected at least once should be included in the risk assessment tables. The tables will be populated based upon the compounds selected. Chemicals that were never detected above detection limits are typically not included in the tables but may be included in the uncertainty section if reporting limits were greater than screening levels. If detection limits are all elevated above particular screening levels, this may indicate that additional data are needed.

Figures 1 and 2 show portions of the *Chemicals* worksheet used to select the chemicals and media to include in the risk assessment.

Chemical Lists to Evaluate	Show All	Hide All	Show Selected	
Volatile Organic Compounds (VOCs)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Select VOCs
Semivolatile Organic Compounds (SVOCs)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select SVOCs
Metals	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select Metals
Volatile Petroleum Hydrocarbons	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Select VPH
Extractable Petroleum Hydrocarbons	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Select EPH
Polychlorinated Biphenyls	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select PCBs
Dioxins and Furans	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Select Dioxins
Chlorinated Herbicides	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select Herbicides
Organochlorine Pesticides	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select Pesticides
Others	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Select Others

**Figure 1** Selection of chemicals to include in the Montana Risk Assessment Tables

	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
Aluminum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Antimony	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arsenic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Barium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beryllium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cadmium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chromium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chromium VI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cobalt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Copper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Iron	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manganese	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mercury	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nickel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Selenium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Silver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thallium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vanadium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Zinc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Figure 2** Dialog box for selecting specific metals to include in the risk assessment

## 2.2 Table 1 – Selection of Exposure Pathways

Table 1.0 summarizes the exposure pathways included in the risk assessment. The table has been pre-populated with receptors and exposure scenarios commonly evaluated in risk assessments of contaminated sites in Montana. The user should review this table and modify it as necessary based on site-specific information to accurately reflect the receptors and exposure pathways being evaluated. Table 1.0 is a summary table. Modifying this table has no impact on other tables in the workbook.

The user should specify a rationale for inclusion or exclusion of each exposure pathway in Table 1.0. The rationales provided in the default table will generally not be sufficient to explain the inclusion or exclusion of exposure pathways for a specific site.

Table 1.0 includes ecological receptors for surface soil, sediment, and surface water. Montana DEQ guidance available at <http://deq.mt.gov/Portals/112/Land/StateSuperfund/documents/Ecorisk.pdf> should be used to determine whether qualitative or quantitative evaluation of ecological receptors is required, and these portions of Table 1.0 should be modified accordingly. Ecological risks are assessed

separately from human health risks and are not included in any other tables within this workbook.

## 2.3 Table 2 – Occurrence, Distribution, and Selection of COPCs

Tables 2.1 through 2.5 provide for the occurrence, distribution, and selection of chemicals of concern in surface soil, subsurface soil, groundwater, surface water, and sediment, respectively. Table 2.6 summarizes the identified COPCs in each medium.

The user should update the exposure area referenced in the Table 2 series to be the site-specific exposure area under evaluation. In Table 2.1, for example, the default exposure point of “Surface soil” in Cell A15 should be updated to reflect the location of that surface soil.

The user should enter the following data in the Table 2 series:

- Minimum and maximum contaminant concentrations in each medium (columns D and F) along with associated data qualifiers (columns E and G). If the minimum or maximum concentration is a non-detect, specify a qualifier of “U”.
- Location of maximum concentration for each contaminant (column I).
- Detection frequency (number of detects in column J; number of samples in column L).
- Minimum and maximum detection limits for each contaminant (columns M and O).
- Background values (column Q). If a background value is not available, leave the column blank or indicate that it is not available with “NA”. Background concentrations of metals in soil are included in the Montana Risk Assessment Tables by default. The default values for metals are the Montana Background Threshold Values for Inorganics in Montana Soils (<http://deq.mt.gov/Portals/112/Land/StateSuperfund/Documents/Copy%20of%20BackgroundMetalsSoilsTable-pdf.pdf>). Site-specific background values may be used with DEQ approval.
- Screening toxicity values (column R) along with a designation as to whether this is based on cancer risk “C” or noncancer risk “N” (column S). If a screening value is not available, leave the column blank or indicate “NA”. EPA residential RSLs or Montana risk-based screening levels based upon residential exposure from the Master Table 4 for petroleum compounds are generally used to screen surface and subsurface soil for direct contact. Commercial/industrial screening levels may not be used for subsurface soil since they are not always more protective than construction worker screening levels. Cancer values should be based on a  $1 \times 10^{-6}$  cancer risk level and noncancer screening values should be based on a hazard quotient of 0.1. Please use the DEQ Surface and Subsurface Soil Screening Flowchart - Part 1 – Direct Exposure for selecting appropriate Montana direct contact screening values (available at: <http://deq.mt.gov/Portals/112/Land/StateSuperFund/Documents/SoilScreenFlowchart2016.pdf?ver=2016-05-19-153548-370>).

- For soil in Tables 2.1 and 2.2, a leaching to groundwater screening value in column T along with a designation for cancer risk or noncancer risk in column U. EPA soil screening levels (SSLs) or Montana RBSLs from the Master Table 4 for petroleum compounds are generally used to screen surface and subsurface soil for leaching to groundwater. Please use the DEQ Surface and Subsurface Soil Screening Flowchart - Part 2 – Leaching to Groundwater for selecting appropriate leaching screening values (available at: <http://deq.mt.gov/Portals/112/Land/StateSuperFund/Documents/SoilScreenFlowchart2016.pdf?ver=2016-05-19-153548-370>).
- For groundwater and surface water in Tables 2.3 and 2.4, respectively, screening values in column R are to be selected from DEQ-7 Human Health Standards or RBCA Tier 1 groundwater RBSLs. If the chemical in question does not have a DEQ-7 standard or RBSL, then the EPA tapwater RSL should be used. Consistent with DEQ-7, cancer values should be based on a  $1 \times 10^{-5}$  cancer risk level and noncancer screening values should be based on a hazard quotient of 1.
- For groundwater and surface water in Tables 2.3 and 2.4, respectively, indicate in column V whether the contaminant should be evaluated quantitatively in the risk assessment. A “Y” value in column V will result in the chemical populating subsequent tables. An “N” or blank value in column V will result in that chemical being excluded from quantitative evaluation. Only contaminants that do not have DEQ-7 human health standards, RBSLs, or tapwater RSLs should be considered for quantitative analysis. If these values are used for a chemical, that chemical should not be further evaluated quantitatively.
- The spreadsheets are designed to include dioxin/furan and carcinogenic polycyclic aromatic hydrocarbon (PAH) toxicity equivalence (TEQ) concentration calculated using toxicity equivalent factors (TEFs) based upon 2,3,7,8-tetrachlorodibenzo(p)dioxin and benzo(a)pyrene. If these concentrations are entered, concentrations of the individual congeners or PAHs are not entered for calculation of risk. Each PAH is entered for screening protection of leaching to groundwater.

When these data are correctly entered, Tables 2.1 through 2.5 are designed to compare the entered contaminant concentrations to screening criteria to determine which chemicals are COPCs. The results will be summarized in Table 2.6. Chemicals for which concentrations exceed leaching criteria but no other screening criteria will be included in Table 2.6 but will not be carried forward in the risk assessment. However, these leaching to groundwater-based COPCs should be further evaluated in a separate site-specific fate and transport evaluation to be performed concurrently with the risk assessment.

The default concentration used for screening is the maximum concentration. Should it be determined that a different concentration would be appropriate for use in comparing to screening levels, the concentration to be used for screening can be entered in shaded column P of Tables 2.1 through 2.5, replacing the default formula(s) in that column. Documentation should be provided supporting the use of a concentration other than the maximum for comparison to screening values.

Because other factors such as toxicity should be considered, contaminants will not be automatically eliminated as contaminants of concern due to low frequency of detection. Should the user wish to eliminate a contaminant of concern due to low frequency of detection, the user may delete the corresponding value used for screening from shaded column P, and then clearly indicate via notes or other documentation that the chemical is being eliminated as a contaminant of concern due to low frequency of detection.

The user may optionally add contaminant concentration data as a separate page at the end of the workbook and then use Excel® lookup or database functions to include the data in Table 2. This may be appropriate for contaminants not detected but with reporting limits above screening levels.

## 2.4 Table 3 – Exposure Point Concentration Summary

### 2.4.1 Soil and Sediment

In Tables 3.1, 3.2, and 3.5 for surface soil, subsurface soil, and sediment, the user enters the arithmetic mean and upper confidence limit (UCL) on the mean in columns D and F for each COPC and medium. A macro automatically includes only contaminants that are identified as COPCs. Other chemicals are excluded by automatically hiding rows of the table. Column E can be used for data qualifiers (*e.g.*, “U” to indicate a contaminant was not detected). Column G can be used to indicate the type of data distribution used to determine the UCL. The arithmetic means and UCLs may be calculated using EPA ProUCL software, by manual calculation, or by other means acceptable to DEQ. All data qualifiers and abbreviations for distribution types should be explained in table notes. The ProUCL outputs, manual calculations, or other means should be provided in an appendix to the risk assessment to assist DEQ with review of the calculations.

Exposure point concentrations should be entered in column J and can reference appropriate values found elsewhere in the table, as appropriate, in accordance with Montana DEQ guidance. The statistic used as the exposure point concentration should be entered in column L, along with the rationale for using that statistic in column M.

### 2.4.2 Groundwater and Surface Water

In Tables 3.3 and 3.4 for groundwater and surface water, the user enters the exposure point concentration in column F along with the rationale for the exposure point concentration in column H. For groundwater and surface water, exposure point concentrations will generally be either the maximum detected concentrations (used for screening purposes), or the detected concentrations at a single sampling location of interest. As for soil and sediment, a macro automatically includes only contaminants that are identified as COPCs in these tables. Other chemicals are excluded by automatically hiding rows of the table.

## 2.5 Table 4 – Values Used for Daily Intake Calculations

Tables 4.1 through 4.5 provide exposure parameters used in the risk calculations. DEQ typically bases risk management decisions on reasonable maximum exposure scenarios. The exposure parameters are those recommended by DEQ and, with the exception of a few parameters identified below, should not be changed without DEQ approval.

The parameters that may be input or modified by the user in consultation with DEQ are all related to recreational exposure to sediment or surface water:

- Sediment ingestion rate (milligrams per day - mg/day)
- Sediment exposure frequency (days/year)
- Sediment adherence factor (milligrams per square centimeter - mg/cm<sup>2</sup>)
- Sediment - Skin surface area exposed (square centimeters per day - cm<sup>2</sup>/day)
- Surface water exposure frequency (days/year)
- Surface water events per day (events/day)
- Surface water exposure time per event (hours/event)

### 2.5.1 Residential Soil Exposure

For residential exposure to soil, an age-adjusted soil ingestion factor and age-adjusted dermal factor are used to calculate lifetime exposure to COPCs. These age-adjusted factors are calculated following the approach used by EPA to derive RSLs (EPA, 2016a).<sup>2</sup>

For most carcinogens, the age-adjusted residential soil ingestion factor ( $IR_{soil/adj}$ ; 105 milligram [mg]-year per kilogram [kg]-day) is calculated as:

$$IR_{soil/adj} = \frac{IR_{soil,child} \times ED_{child}}{BW_{child}} + \frac{IR_{soil,adult} \times ED_{adult}}{BW_{adult}}$$

where the terms are defined as:

$IR_{soil,child}$	Soil ingestion rate for children (200 mg/day);
$ED_{child}$	Exposure duration for children (6 years);
$BW_{child}$	Body weight for children (15 kg);
$IR_{soil,adult}$	Soil ingestion rate for adults (100 mg/day);
$ED_{adult}$	Exposure duration for adults (20 years); and
$BW_{adult}$	Body weight for adults (80 kg).

For mutagens, the age-adjusted soil ingestion factor (477 mg-yr/kg-day) is calculated similarly, with mutagenicity factors of 10 for the period from birth to age 2, 3 for the period from ages 2 to 6, 3 for the period from ages 6 to 16, and 1 for the period from ages 16 to 26.

For most carcinogens, the age-adjusted dermal factor ( $SFS_{adj}$ ; 295 mg-yr/kg-day) is calculated as:

$$SFS_{adj} = \frac{SA_{child} \times AF_{child} \times ED_{child}}{BW_{child}} + \frac{SA_{adult} \times AF_{adult} \times ED_{adult}}{BW_{adult}}$$

<sup>2</sup> Note that EPA RSL tables and equations are usually updated biannually most often in May and November each year. It is the users responsibility to determine the current screening levels.

where the new terms are defined as:

$SA_{child}$	Skin surface area for children (2,373 cm <sup>2</sup> /day);
$AF_{child}$	Adherence factor for children (0.2 mg/cm <sup>2</sup> );
$SA_{adult}$	Skin surface area for adults (6,032 cm <sup>2</sup> /day); and
$AF_{adult}$	Adherence factor for adults (0.07 mg/cm <sup>2</sup> ).

For mutagens, the age-adjusted dermal factor (1,224 mg-yr/kg-day) is calculated similarly, but with mutagenicity factors of 10 for the period from birth to age 2, 3 for the period from ages 2 to 6, 3 for the period from ages 6 to 16, and 1 for the period from ages 16 to 26.

When calculating inhalation risks for residents, cancer risks associated with mutagens are calculated by adjusting the exposure duration by mutagenicity factors of 10 for ages 0 to 2, 3 for ages 2 to 6 and 6 to 16, and 1 for ages 16 to 26. Risks for mutagens are calculated by assuming an effective exposure period of 72 years instead of 26 years (10 × 2 years) + (3 × 14 years) + (1 × 10 years).

### 2.5.2 Residential Use of Groundwater as Drinking Water

Ingestion of groundwater as drinking water should only be quantitatively evaluated for contaminants that do not have DEQ-7 human health standards, RBSLs, or tapwater RSLs. The methods used to evaluate this pathway are similar to the derivation of the tapwater RSLs. For residential use of groundwater as a source of drinking water, an age-adjusted water ingestion factor is used to calculate lifetime exposure to COPCs. For most carcinogens, the age-adjusted water ingestion factor ( $IR_{water/adj}$ ; 0.937 liters [L]-year per kilogram [kg]-day) is calculated as:

$$IR_{water/adj} = \frac{IR_{water,child} \times ED_{child}}{BW_{child}} + \frac{IR_{water,adult} \times ED_{adult}}{BW_{adult}}$$

where the new terms are defined as:

$IR_{water,child}$	Water ingestion rate for children (0.78 L/day); and
$IR_{water,adult}$	Water ingestion rate for adults (2.5 L/day).

For mutagens, the age-adjusted water ingestion factor (2.914 L-yr/kg-day) is calculated similarly, but with mutagenicity factors of 10 for the period from birth to age 2, 3 for the period from ages 2 to 6, 3 for the period from ages 6 to 16, and 1 for the period from ages 16 to 26.

### 2.5.3 Recreator/Trespasser Scenarios

For the recreator/trespasser scenarios, exposure for mutagens is adjusted by a factor of 2.67. This accounts for a mutagenicity factor of 3 for the first 10 years of exposure between the ages of 6 and 16 and a mutagenicity factor of 1 for the final 2 years of exposure between the ages of 16 and 18.

In the vinyl chloride cancer risk calculations for the recreator/trespasser scenario, vinyl chloride is treated as a normal carcinogen, not as a mutagen. The ages considered in the recreator/trespasser scenario are ages 6 to 16. EPA estimates risks associated with vinyl chloride using two terms – one accounts for exposure to vinyl chloride during early-life exposure when an infant or child is particularly vulnerable to vinyl chloride, while the second accounts for

the more traditionally-defined risk directly related to exposure duration and frequency. Because the recreator/trespasser scenario does not include infants or children younger than age 6, only the more traditional calculation is performed for these scenarios.

For recreator dermal contact with surface water, a water dermal contact factor is used to calculate exposure to COPCs. This recreator water dermal contact factor ( $DFW_{rec-adj}$  in  $\text{cm}^2\text{-event/kg}$ ) is calculated as:

$$DFW_{rec-adj} = \frac{EV_{sw} \times ED_{rec} \times EF_{sw} \times SA_{sw}}{BW_{rec}}$$

where the terms are defined as:

$EV_{sw}$	Surface water contact events per day (events/day);
$ED_{rec}$	Exposure duration for the recreator (12 years);
$EF_{sw}$	Exposure frequency to surface water (days/year);
$SA_{sw}$	Skin area exposed to surface water (19,652 $\text{cm}^2$ ); and
$BW_{rec}$	Body weight for recreators (45 kg).

The number of surface water contact events per day and exposure frequency to surface water are site-specific values that should be entered by the user.

### 2.5.4 Chemical-Specific Parameters

Chemical-specific dermal absorption factors for soil, relative bioavailability factors for soil, and volatilization factors should be entered in Table 4.6. The relative bioavailability factor currently used by EPA (2016c) for arsenic is 0.6. Relative bioavailability factors for soil will be 1 for most other contaminants. This default value of 1 is included in Table 4.6 for all chemicals other than arsenic. DEQ should be consulted in advance if site-specific bioavailability is available for other chemicals.

If recreator dermal exposure to surface water is being evaluated quantitatively, the fractions absorbed and dermal permeability constants should be entered for each COPC being evaluated quantitatively. Default values for molecular weight are included in Table 4.6. The EPA RSL chemical parameters table (EPA, 2016a) is recommended as a reference for obtaining these chemical-specific values.

## 2.6 Tables 5 & 6 – Toxicity Data

Toxicity data for COPCs are entered in Tables 5 and 6. DEQ follows the EPA toxicity hierarchy referenced in *Human Health Toxicity Values in Superfund Risk Assessments* (EPA, 2003). Data to be entered (and the columns in which to enter the data) include:

- Oral reference doses in units of  $\text{mg/kg-day}$  (Table 5.1, Column C). Column B should indicate whether the reference dose is chronic or subchronic. DEQ uses chronic reference doses for all receptors, so column B will indicate chronic values.
- Oral absorption efficiencies used to calculate an absorbed reference dose for dermal exposure (Table 5.1, Column E)

- Primary target organs for oral or dermal exposure (Table 5.1, Column H)
- Combined uncertainty/modifying factors for the reference dose (Table 5.1, Column I)
- Sources and dates for the reference dose and target organs (Table 5.1, Columns J and K)
- Inhalation reference concentrations in units of milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ) (Table 5.2, Column C). Column B should indicate whether the reference concentration is chronic or subchronic. DEQ uses chronic reference concentrations for all receptors, so column B will indicate chronic values.
- Primary target organs for inhalation exposure (Table 5.2, Column E)
- Combined uncertainty/modifying factors for the reference concentration (Table 5.2, Column F).
- Sources and dates for the reference concentration and target organs (Table 5.2, Columns G and H).
- Oral cancer slope factors in units of  $(\text{mg}/\text{kg}\text{-day})^{-1}$  (Table 6.1, Column C)
- Oral absorption efficiencies used to calculate an absorbed cancer slope factor for dermal exposure (Table 6.1, Column E)
- Weight of evidence or cancer guideline description for the oral cancer slope factor (Table 6.1, Column H). This will generally be a description such as “Inadequate information”, “Suggestive”, or a cancer class such as “B2”.
- Sources and dates for oral cancer slope factors (Table 6.1, Columns I and J)
- Inhalation unit risks (IURs) in units of  $(\mu\text{g}/\text{m}^3)^{-1}$  (Table 6.2, Column B).
- Weight of evidence or cancer guideline description for the inhalation unit risk (Table 6.2, Column D)
- Sources and dates for the inhalation unit risks (Table 6.2, Columns E and F)

### 2.6.1 Vinyl chloride

EPA has derived multiple cancer slope factors and inhalation unit risks for vinyl chloride based on differing extrapolation methods and depending on whether the period of evaluation is continuous lifetime exposure during adulthood or continuous lifetime exposure from birth (EPA, 2016). The calculations performed in the spreadsheet to evaluate risks associated with exposure to vinyl chloride are based on those used by EPA in the derivation of RSLs (EPA, 2016a). The EPA RSLs are based on the oral cancer slope factor of  $7.2 \times 10^{-1} (\text{mg}/\text{kg}\text{-day})^{-1}$  for continuous lifetime exposure during adulthood and the inhalation unit risk of  $4.4 \times 10^{-3} (\text{mg}/\text{m}^3)^{-1}$  for continuous lifetime exposure during adulthood. These toxicity values are in the Integrated Risk Information System (EPA 2016b). It is therefore recommended that these toxicity factors be used to evaluate risks associated with exposure to vinyl chloride.

## 2.6.2 Trichloroethylene

The evaluation of trichloroethylene (TCE) as a carcinogen and a mutagen requires the use of different toxicity values for evaluating standard carcinogenic exposure and mutagenicity (EPA, 2016a). The spreadsheet calculates risks associated with TCE using toxicity value adjustment factors to combine standard cancer and mutagenic modes of action as is done by EPA in the calculation of RSLs. The calculations are based on the adult-based oral cancer slope factor of  $4.6 \times 10^{-2} \text{ (mg/kg-day)}^{-1}$  and inhalation unit risk of  $4.1 \times 10^{-3} \text{ (mg/m}^3\text{)}^{-1}$ . These values should be specified as the toxicity values for TCE.

## 2.6.3 Lead

Lead is a developmental toxin that cannot be evaluated using the methods implemented in the Montana Risk Assessment Tables. When evaluating lead, leave the reference dose, reference concentration, oral cancer slope factor, and inhalation unit risk blank in Tables 5 and 6. A risk assessor should separately evaluate potential health risks associated with lead.

## 2.7 Table 7 – Calculation of Risk Estimates

Non-cancer hazards and cancer risks associated with exposure to COPCs are calculated in Tables 7.1 through 7.10. The user may wish to modify the exposure point identified in column C of each table. These tables require no further input from the user to produce risk estimates based on the data entered in preceding tables. The equations used to calculate health risk estimates are those used by both Montana DEQ and EPA (2016a).

## 2.8 Table 9 – Summary of Risk Estimates

Table 9 summarizes all risk estimates. The user may wish to edit the exposure point descriptions in column C, but should not need to make other adjustments to the table.

## 2.9 Summary Tables of Risk Characterization Results and Cleanup Levels

Summary Tables 1 through 10 calculate cleanup levels for contaminants having hazard indices greater than 0.1 or incremental cancer risks greater than  $1 \times 10^{-6}$ . By default, the cleanup levels are based on a target hazard index of 0.1 and a target cancer risk of  $1 \times 10^{-6}$  per chemical. The user may change the target hazard indices and target risks in the tables based on the stated goals for the cleanup. If, for example, the goal is to remediate the site to a level such that the total hazard index for the site associated with each target organ is 1, then the user may wish to allocate the total hazard index of one among all chemicals having the same target organ.

Similarly, if the goal is for the total cancer risk to be less than  $1 \times 10^{-5}$ , then this total allowable cancer risk could be split among the carcinogens being evaluated.

## Section 3

### References

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EPA (2016c). *Regional Screening Levels (RSLs) – User’s Guide* (May 2016).

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Massachusetts DEP (2010). *Quality Control Requirements and Performance Standards for the Analysis of Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) in Support of Response Actions under the Massachusetts Contingency Plan (MCP)*. Bureau of Waste Site Cleanup. Boston, MA. WSC-CAM-IIB. July 1, 2010.

# Appendix A

## Chemicals Included in the Montana Risk Assessment Tables

Chemicals and associated Chemical Abstracts Service Registry Numbers (CASRN) included in the risk assessment tables are listed below.

### **Volatile Organic Compounds (VOCs)**

67-64-1	Acetone
994-05-8	tert-Amyl methyl ether
71-43-2	Benzene
108-86-1	Bromobenzene
74-97-5	Bromochloromethane
75-27-4	Bromodichloromethane
75-25-2	Bromoform
74-83-9	Bromomethane
106-99-0	1,3-Butadiene
135-98-8	sec-Butylbenzene
104-51-8	n-Butylbenzene
98-06-6	tert-Butylbenzene
75-15-0	Carbon disulfide
56-23-5	Carbon tetrachloride
108-90-7	Chlorobenzene
124-48-1	Chlorodibromomethane
75-00-3	Chloroethane
67-66-3	Chloroform
74-87-3	Chloromethane
95-49-8	2-Chlorotoluene
106-43-4	4-Chlorotoluene
110-82-7	Cyclohexane
96-12-8	1,2-Dibromo-3-chloropropane
106-93-4	1,2-Dibromoethane
74-95-3	Dibromomethane
95-50-1	1,2-Dichlorobenzene
541-73-1	1,3-Dichlorobenzene
106-46-7	1,4-Dichlorobenzene
75-71-8	Dichlorodifluoromethane
75-34-3	1,1-Dichloroethane
107-06-2	1,2-Dichloroethane
75-35-4	1,1-Dichloroethene
156-59-2	cis-1,2-Dichloroethene
156-60-5	trans-1,2-Dichloroethene
78-87-5	1,2-Dichloropropane
142-28-9	1,3-Dichloropropane
594-20-7	2,2-Dichloropropane

563-58-6	1,1-Dichloropropene
10061-01-5	cis-1,3-Dichloropropene
10061-02-6	trans-1,3-Dichloropropene
60-29-7	Diethyl ether
108-20-3	Diisopropyl ether
123-91-1	1,4-Dioxane
637-92-3	Ethyl tertiary butyl ether
100-41-4	Ethylbenzene
87-68-3	Hexachlorobutadiene
110-54-3	Hexane
591-78-6	2-Hexanone
98-82-8	Isopropylbenzene
99-87-6	p-Isopropyltoluene
78-93-3	Methyl ethyl ketone
108-10-1	Methyl isobutyl ketone
1634-04-4	Methyl tertiary butyl ether
75-09-2	Methylene chloride
91-20-3	Naphthalene
103-65-1	n-Propylbenzene
100-42-5	Styrene
630-20-6	1,1,1,2-Tetrachloroethane
79-34-5	1,1,2,2-Tetrachloroethane
127-18-4	Tetrachloroethene
109-99-9	Tetrahydrofuran
108-88-3	Toluene
120-82-1	1,2,4-Trichlorobenzene
87-61-6	1,2,3-Trichlorobenzene
71-55-6	1,1,1-Trichloroethane
79-00-5	1,1,2-Trichloroethane
79-01-6	Trichloroethene
75-69-4	Trichlorofluoromethane
96-18-4	1,2,3-Trichloropropane
95-63-6	1,2,4-Trimethylbenzene
108-67-8	1,3,5-Trimethylbenzene
75-01-4	Vinyl chloride
1330-20-7	Xylenes

**Semivolatile Organic Compounds (SVOCs)**

83-32-9	Acenaphthene
208-96-8	Acenaphthylene
98-86-2	Acetophenone
62-53-3	Aniline
120-12-7	Anthracene
103-33-3	Azobenzene
56-55-3	Benzo(a)anthracene
50-32-8	Benzo(a)pyrene
NA	Benzo(a)pyrene PAH TEQ
205-99-2	Benzo(b)fluoranthene
191-24-2	Benzo(g,h,i)perylene
207-08-9	Benzo(k)fluoranthene

101-55-3	4-Bromophenyl phenyl ether
85-68-7	Butyl benzyl phthalate
84-74-2	di-n-Butyl phthalate
106-47-8	4-Chloroaniline
111-91-1	bis (2-Chloroethoxy)methane
111-44-4	bis (2-Chloroethyl)ether
108-60-1	bis (2-Chloroisopropyl)ether
91-58-7	2-Chloronaphthalene
95-57-8	2-Chlorophenol
218-01-9	Chrysene
53-70-3	Dibenz(a,h)anthracene
132-64-9	Dibenzofuran
95-50-1	1,2-Dichlorobenzene
541-73-1	1,3-Dichlorobenzene
106-46-7	1,4-Dichlorobenzene
91-94-1	3,3'-Dichlorobenzidine
120-83-2	2,4-Dichlorophenol
84-66-2	Diethyl phthalate
105-67-9	2,4-Dimethylphenol
131-11-3	Dimethyl phthalate
51-28-5	2,4-Dinitrophenol
121-14-2	2,4-Dinitrotoluene
606-20-2	2,6-Dinitrotoluene
123-91-1	1,4-Dioxane
117-81-7	bis (2-Ethylhexyl) phthalate
206-44-0	Fluoranthene
86-73-7	Fluorene
118-74-1	Hexachlorobenzene
87-68-3	Hexachlorobutadiene
67-72-1	Hexachloroethane
193-39-5	Indeno(1,2,3-cd)pyrene
78-59-1	Isophorone
90-12-0	1-Methylnaphthalene
91-57-6	2-Methylnaphthalene
95-48-7	2-Methylphenol
108-39-4	3-Methylphenol
106-44-5	4-Methylphenol
91-20-3	Naphthalene
98-95-3	Nitrobenzene
88-75-5	2-Nitrophenol
100-02-7	4-Nitrophenol
117-84-0	di-n-Octyl phthalate
87-86-5	Pentachlorophenol
85-01-8	Phenanthrene
108-95-2	Phenol
129-00-0	Pyrene
78-00-2	Tetraethyl lead
120-82-1	1,2,4-Trichlorobenzene
95-95-4	2,4,5-Trichlorophenol
88-06-2	2,4,6-Trichlorophenol

**Metals**

7429-90-5	Aluminum
7440-36-0	Antimony
7440-38-2	Arsenic
7440-39-3	Barium
7440-41-7	Beryllium
7440-43-9	Cadmium
7440-47-3	Chromium
18540-29-9	Chromium VI
7440-48-4	Cobalt
7440-50-8	Copper
7439-89-6	Iron
7439-92-1	Lead
7439-96-5	Manganese
7439-97-6	Mercury
7440-02-0	Nickel
7782-49-2	Selenium
7440-22-4	Silver
7440-28-0	Thallium
7440-62-2	Vanadium
7440-66-6	Zinc

**Volatile Petroleum Hydrocarbons**

NA	C5-C8 Aliphatics
NA	C9-C12 Aliphatics
NA	C9-C10 Aromatics
71-43-2	Benzene
100-41-4	Ethylbenzene
1634-04-4	Methyl tertiary butyl ether
91-20-3	Naphthalene
108-88-3	Toluene
1330-20-7	Xylenes

**Extractable Petroleum Hydrocarbons**

NA	C9-C18 Aliphatics
NA	C19-C36 Aliphatics
NA	C11-C22 Aromatics
83-32-9	Acenaphthene
208-96-8	Acenaphthylene
120-12-7	Anthracene
56-55-3	Benzo(a)anthracene
50-32-8	Benzo(a)pyrene
NA	Benzo(a)pyrene PAH TEQ
205-99-2	Benzo(b)fluoranthene
191-24-2	Benzo(g,h,i)perylene
207-08-9	Benzo(k)fluoranthene
218-01-9	Chrysene
53-70-3	Dibenz(a,h)anthracene
206-44-0	Fluoranthene

86-73-7	Fluorene
193-39-5	Indeno(1,2,3-cd)pyrene
90-12-0	1-Methylnaphthalene
91-57-6	2-Methylnaphthalene
91-20-3	Naphthalene
85-01-8	Phenanthrene
129-00-0	Pyrene

**Polychlorinated Biphenyls**

12674-11-2	Aroclor 1016
11104-28-2	Aroclor 1221
11141-16-5	Aroclor 1232
53469-21-9	Aroclor 1242
12672-29-6	Aroclor 1248
11097-69-1	Aroclor 1254
11096-82-5	Aroclor 1260
1336-36-3	Total PCBs

**Dioxins and Furans**

1746-01-6	2,3,7,8-TCDD TEQ
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**Chlorinated Herbicides**

50594-66-6	Acifluorfen
25057-89-0	Bentazon
133-90-4	Chloramben
94-75-7	2,4-D
75-99-0	Dalapon
94-82-6	2,4-DB
2136-79-0	DCPA diacid
1918-00-9	Dicamba
51-36-5	3,5-Dichlorobenzoic acid
120-36-5	Dichloroprop
88-85-7	Dinoseb
7600-50-2	5-Hydroxydicamba
94-74-6	MCPA
93-65-2	MCPP
100-02-1	4-Nitrophenol
87-86-5	Pentachlorophenol
1918-02-1	Picloram
93-76-5	2,4,5-T
93-72-1	2,4,5-TP (Silvex)

**Organochlorine Pesticides**

309-00-2	Aldrin
319-84-6	$\alpha$ -BHC
319-85-7	$\beta$ -BHC
58-89-9	$\gamma$ -BHC (Lindane)
319-86-8	$\delta$ -BHC
5103-71-9	cis-Chlordane
5103-74-2	trans-Chlordane

57-74-9	Chlordane
510-15-6	Chlorobenzilate
96-12-8	1,2-Dibromo-3-chloropropane
72-54-8	4,4'-DDD
72-55-9	4,4'-DDE
50-29-3	4,4'-DDT
2303-16-4	Diallate
60-57-1	Dieldrin
959-98-8	Endosulfan I
33213-65-9	Endosulfan II
1031-07-8	Endosulfan sulfate
72-20-8	Endrin
7421-93-4	Endrin aldehyde
53494-70-5	Endrin ketone
76-44-8	Heptachlor
1024-57-3	Heptachlor epoxide
118-74-1	Hexachlorobenzene
77-47-4	Hexachlorocyclopentadiene
465-73-6	Isodrin
121-75-5	Malathion
72-43-5	Methoxychlor
8001-35-2	Toxaphene

**Others**

57-12-5	Cyanide
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NA indicates that no CASRN is available for the COPC.

