

**Missouri Risk-Based Corrective Action
Default Target Levels
and
Tier 1 Risk-Based Target Levels
Update**

**Missouri Department of Health and Senior Services
Project Proposal**

September 2013

As a cooperative effort between the Missouri Department of Natural Resources (MDNR) and the Missouri Department of Health and Senior Services (MDHSS), MDHSS is updating Missouri's Risk-Based Corrective Action (MRBCA) Default Target Levels (DTLs) and Tier 1 Risk-Based Target Levels (RBTLs). As part of this cooperative effort, MDHSS has prepared this project proposal detailing our recommendations for completing this update. Once concurrence has been reached on the issues contained in this proposal, MDHSS will proceed with the update.

Below is our general approach to completing the update followed by recommended changes for calculating the DTLs and Tier 1 RBTLs.

MDHSS GENERAL APPROACH

MDHSS believes changes are needed in MRBCA to provide a more scientifically defensible and consistent framework for providing risk-based guidance. Specifically, MDHSS recommends the DTLs and RBTLs be modified to incorporate current U.S. Environmental Protection Agency (EPA) risk assessment guidance. MDHSS recommends that the MRBCA target levels be updated to be consistent with EPA's Regional Screening Levels (RSLs) (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm) along with recommendations found in the following EPA guidance documents:

- [*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual. \(Part A\)*, 1989.](#)
- [*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual \(Part B, Development of Risk-Based Preliminary Remediation Goals\)*, 1991.](#)
- [*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual \(Part E, Supplemental Guidance for Dermal Risk Assessment\)*, 2004.](#)
- [*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual \(Part F, Supplemental Guidance for Inhalation Risk Assessment\)*, 2009.](#)
- [EPA Soil Screening Guidance:](#)
 - *Soil Screening Guidance User's Guide*, 1996.
 - *Soil Screening Guidance Technical Background Document*, 1996.
 - *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, 2002.
- [*Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils \(Subsurface Vapor Intrusion Guidance\)*, 2002.](#)
- [*Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*, 2005.](#)
- [EPA Lead Risk Assessment Guidance](#)

Planned Completion Date ¹	Project Deliverable
Oct. 31, 2013	<ul style="list-style-type: none"> • Draft DTLs and Tier 1 RBTLs (including tables, models/equations, and inputs for MRBCA guidance)
Dec. 31, 2013	<ul style="list-style-type: none"> • Remaining documentation required for MRBCA guidance and for the final project report (for transparency and documentation purposes, MDNR intends to develop a project report that will detail all information necessary as to the how and why the RBTLs were updated – MDHSS will be supplying necessary documentation to MDNR in support of this) • Draft Tier 2 Site-Specific Target Level (SSTL) calculator (excel workbook with user instructions)

¹Please note that meeting the proposed timeline is dependent on reaching agreement between MDNR and MDHSS on equations/inputs, etc.

MRBCA Guidance

MDHSS will complete the update following the general approach outlined in MRBCA guidance. This general approach is as follows:

Target Risk Levels:

- Carcinogenic Risk – Individual Excess Lifetime Cancer Risk (IELCR) of 1E-5
- Non-Carcinogenic Risk – Hazard Quotient (HQ) of 1

Selection of DTLs: lowest of all Tier 1 RBTLs

Tier 1 RBTL Calculations:

- All Exposure Pathways for Soil, Groundwater, and Air for the following receptor populations:
 - Residential Land Use – Tier 1 RBTLs will be selected based on the lowest of child resident, adult resident, and age-adjusted resident
 - Non-Residential Land Use
 - Construction Worker
- Soil concentrations protective of domestic use of groundwater pathway
- Saturated Soil Concentrations

MRBCA currently incorporates three soil types; however, as previously agreed to, MDHSS will calculate soil target levels using only one soil type.

Groundwater RBTLs and EPA Maximum Contaminant Levels (MCLs) will be provided on the RBTL tables for ease of comparison. In addition, soil concentrations protective of domestic water use will also be provided on the RBTL tables for ease of comparison. Saturated soil concentrations (C_{sat}) will additionally be provided on the tables with an indication of when C_{sat} is lower than the calculated receptor-specific soil RBTL.

For documentation purposes, MDHSS will provide source references for all models/equations and input parameters and will additionally document all changes to toxicity values for the chemicals currently listed in MRBCA.

MDHSS will also perform a detailed review of applicable sections of the MRBCA guidance and will provide text edits to MDNR as needed.

MRBCA Tier 2 SSTL Calculator

MDHSS will develop a Tier 2 SSTL calculator to replace the current MRBCA Computational Software. The calculator will follow the same basic methodology used to calculate the Tier 1 RBTLs, but will incorporate options to modify fate and transport for conducting a Tier 2 risk assessment and when calculating site-specific target levels. This calculator will be developed in close consultation with MDNR to ensure the product is user-friendly and adequately supports the needs of conducting a Tier 2 risk assessment.

The current proposal is for MDHSS to develop a Tier 2 calculator; however, there are also the options of MDHSS developing:

- A DTL and Tier 1 spreadsheet that would simplify and potentially reduce errors in the comparison process and the calculation of cumulative site-wide risk.
- A Tier 3 SSTL calculator with options to modify other parameters such as the use of current toxicity values that are allowed at the Tier 3 level.

Please let MDHSS know if MDNR would like to discuss these options.

MDHSS RECOMMENDATIONS

MDHSS recommends the DTLs and Tier 1 RBTLs be based on default EPA assumptions in order to represent conservative Reasonable Maximum Exposure (RME) scenarios to protect public health. The RME is defined as the highest exposure that is reasonably expected to occur at a site. The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures.

MDHSS has briefly reviewed the MRBCA guidance in relation to the development of DTLs and Tier 1 RBTLs and has identified recommendations for changes. Please note that during the process of completing the update, if MDHSS identifies additional items needing change, MDHSS will consult with MDNR prior to making the change.

Our specific recommendations for changes to models/equations, exposure factors, toxicity values, chemical-specific parameters, and fate and transport parameters are provided below.

Please note that these recommendations apply to calculation of the DTLs and Tier 1 RBTLs; however, the majority of the recommendations would also apply at the Tier 2 and Tier 3 levels.

MRBCA MODELS/EQUATIONS

For consistency in the cleanup of contaminated sites in our state and to ensure that the equations used produce conservative levels protective of public health, MDHSS recommends that the models and equations to develop DTLs and Tier 1 RBTLs be updated based on current science and be derived from EPA sources where available.

MDHSS has reviewed the models and equations provided in Section E.10 (specific to lead) and Section E.12 of the MRBCA guidance and recommends changes as described below.

Mutagenic Equations

Applies to:

- All MRBCA equations for the Child Resident and Age-Adjusted Resident. Mutagenic equations are applied only to specific chemicals and pathways for which a mutagenic mode of action has been identified.

Currently, the MRBCA equations do not incorporate EPA's mutagenic equations that account for evidence of higher cancer risks following early-life exposure. Historically, the focus on cancer has been as a disease associated with aging, resulting from extended exposure duration with prolonged latency periods before the cancers appear. This methodology to estimate cancer risk relies on estimation of the lifetime average daily dose, which can account for differences between adult and child exposure factors. However, susceptibility differences with respect to early life stages are not taken into consideration because cancer slope factors are based upon effects observed following exposures to adult humans or mature animals. EPA's *Guidelines for Carcinogen Risk Assessment* (<http://www.epa.gov/cancerguidelines/>) have evolved over the years to reflect the increasing scientific understanding of the processes of cancer development. Part of this evolution has been the consideration of possible sensitive subpopulations and/or life stages. To address the consideration of childhood risks, EPA issued *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (<http://www.epa.gov/cancerguidelines/guidelines-carcinogen-supplement.htm>). As part of this guidance, EPA currently recommends the use of the age-dependent adjustment factors (ADAFs) for carcinogens acting through a mutagenic mode of action. Therefore, MDHSS recommends incorporation of separate cancer risk equations for mutagens into MRBCA. Please note that in addition to the standard mutagenic equations, there currently are specialized equations for specific chemicals (trichloroethylene and vinyl chloride) that should also be incorporated into MRBCA. EPA's RSL table along with Section 5.16 of EPA's RSL User's Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm) provides information on those contaminants currently considered carcinogenic by a mutagenic mode of action.

Inhalation Equations for all scenarios

Applies to MRBCA Equations:

- E-16 Indoor Inhalation of Vapors (Child and Adult Resident, Non-Residential Worker)
- E-17 Outdoor Inhalation of Vapors (Construction Worker)
- E-20 Domestic Water Use (Child and Adult Resident)

- E-24 Inhalation of Vapors and Particulates of Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-25 Inhalation of Vapors and Particulates, Dermal Contact With, and Ingestion of Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-27 Indoor Inhalation of Vapors (Age-Adjusted Resident)
- E-31 Domestic Water Use (Age-Adjusted Resident)
- E-38 Inhalation of Vapors and Particulates of Chemicals in Soil (Age-Adjusted Resident)
- E-40 Inhalation of Vapors and Particulates, Dermal Contact With, and Ingestion of Chemicals in Soil (Age-Adjusted Resident)

Currently, MRBCA equations do not incorporate EPA's updated equations and recommendations for assessing inhalation exposure risks. In 2009, EPA released *Risk Assessment Guidance for Superfund, Part F: Supplemental Guidance for Inhalation Risk Assessment* (<http://www.epa.gov/oswer/riskassessment/ragsf/index.htm>) in which their approach for determining risk from inhaled chemicals was updated to be consistent with inhalation dosimetry methodology. According to the current recommended approach for estimating inhalation risk, the concentration of the chemical in air should be used as the exposure metric (e.g., mg/m³) rather than inhalation intake of a contaminant in air based on inhalation rate and body weight (e.g., mg/kg-day). The intake-based approach is not consistent with the principles of EPA's inhalation dosimetry methodology because the amount of the chemical that reaches the target site is not a simple function of inhalation rate and body weight. Instead, the interaction of the inhaled contaminant with the respiratory tract is affected by a variety of factors which are accounted for in the development of inhalation toxicity values. MDHSS recommends that this current approach to estimating exposures to inhaled contaminants be incorporated into MRBCA.

Inhalation of Vapors and Particulates from Soil for the Construction Worker scenario

Applies to MRBCA Equations (for the construction worker scenario only):

- E-24 Inhalation of Vapors and Particulates of Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-25 Inhalation of Vapors and Particulates, Dermal Contact With, and Ingestion of Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-45 Volatilization Factors (Surficial Soil to Outdoor Air)
- E-46 Volatilization Factors (Particulate Emissions from Surficial Soil)

Currently, MRBCA equations do not incorporate EPA's equations on inhalation of volatiles and fugitive dusts that are unique to construction activities. In EPA's original *Soil Screening Guidance* (<http://www.epa.gov/superfund/health/conmedia/soil/index.htm>), screening level equations were presented for the inhalation of volatiles and fugitive dusts assuming that a site is undisturbed by anthropogenic processes. While this is a reasonable assumption for many potential future activities at a site, it does not account for construction that may be required to redevelop a site. Activities such as excavation and traffic on unpaved roads can result in extensive soil disturbance and dust generation that may lead to increased emissions of volatiles and particulates for the duration of the construction project. To address such

increased short-term exposures, EPA issued *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_main.pdf), which provides separate equations for the volatilization factor (VF) and the particulate emission factor (PEF) parameters for receptor scenarios with chronic exposure and for construction scenarios with subchronic exposure. MRBCA only incorporates the equations from EPA's guidance that are intended for chronic exposures. MDHSS recommends updating MRBCA to incorporate the equations specific to the construction worker scenario. Section 5 of EPA's Supplemental Guidance provides details on the equations and assumptions regarding soil exposure that are unique to construction workers.

Inhalation of Vapors from Groundwater for the Construction Worker scenario

Applies to MRBCA Equations:

- E-44 Groundwater Concentrations Protective of Outdoor Vapor Inhalation
- E-50 Volatilization Factors (Groundwater to Outdoor Air)
- E-51 Effective Diffusion Coefficients

The MRBCA equation for outdoor inhalation from vapors for construction workers is an ASTM equation. Currently, EPA does not have a standard equation available for this pathway. The ASTM equation, however, appears to estimate volatilization of vapors from contaminated groundwater to the ambient air. Because a worker in a trench may have higher degree of exposure than a worker at the surface, MDHSS recommends using a model to estimate trench worker exposure to be representative of an RME scenario. The Virginia Department of Environmental Quality (VDEQ) has developed a model to estimate the air concentration of a contaminant in a trench

(<http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance/Guidance.aspx>). This model is widely-known and used in the risk assessment community; therefore, MDHSS recommends that the use of this model be incorporated into MRBCA. This model incorporates two scenarios that are possible for construction worker exposure to groundwater. In the first scenario, the depth to groundwater is below the level of the construction trench and vapors migrate from the groundwater through the soil and collect in the trench. In the second scenario, the construction trench reaches the groundwater, causing groundwater to pool at the bottom and vapors accumulate in the trench. MDHSS recommends the most conservative of these equations be incorporated for the Tier 1 RBTLs. This could be modified at a Tier 2 or 3 risk assessment based on site conditions. Sections 2.4.3.2 and 3.2.2 of VDEQ's risk assessment guidance contain additional information on the model and assumptions.

Vapor Intrusion Equations

Applies to MRBCA Equations:

- E-41 Subsurface Soil Vapor Concentrations Protective of Indoor Vapor Inhalation
- E-42 Subsurface Soil Concentrations Protective of Indoor Vapor Inhalation
- E-43 Groundwater Concentrations Protective of Indoor Vapor Inhalation
- E-47 Volatilization Factors (Subsurface Soil Vapor to Indoor Air)
- E-48 Volatilization Factors (Subsurface Soil to Indoor Air)
- E-49 Volatilization Factors (Groundwater to Indoor Air)

- E-51 Effective Diffusion Coefficients
- E-54 Soil Concentration at Which Dissolved Pore Water and Vapor Phases Become Saturated
- E-55 Soil Vapor Concentration at Which Vapor Phase Becomes Saturated
- E-56 Domenico Model: Dilution Attenuation Factor (DAF) in the Saturated Zone
- E-58 Allowable Soil and Groundwater Concentration Protective of Indoor Inhalation for Resident and Non-Residential Worker

Currently, MRBCA equations for vapor intrusion do not incorporate EPA’s recommended approach for assessing vapor intrusion. For a screening-level assessment, EPA currently recommends the use of screening levels calculated from the target indoor air concentration using empirically-based conservative “generic” attenuation factors that reflect generally reasonable worst-case conditions as described in EPA’s *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (<http://www.epa.gov/epawaste/hazard/correctiveaction/eis/vapor.htm>) in order to be protective for an RME scenario. EPA’s RSL tables do not directly address vapor intrusion; however, as a companion to EPA’s RSLs, EPA has developed the Vapor Intrusion Screening Level (VISL) Calculator (<http://www.epa.gov/oswer/vaporintrusion/guidance.html#Item6>), a spreadsheet tool that provides recommended screening-level concentrations for groundwater, soil gas (exterior to buildings and sub-slab), and indoor air. The VISLs are calculated using the recommended approaches and attenuation factors in existing guidance and are based on current understanding of the vapor intrusion pathway. Additionally, EPA recommends a multiple lines of evidence approach and generally does not recommend that modeling alone be used to rule out vapor intrusion. At a Tier 1 assessment, MRBCA currently incorporates modeling methodology that is intended for a site-specific evaluation of potential vapor intrusion risks rather than a screening-level assessment. MDHSS recommends that MRBCA incorporate EPA’s current recommended approach to assessing vapor intrusion. For a site-specific evaluation performed at a Tier 2 or Tier 3 risk assessment, MRBCA could incorporate references to appropriate models that could be used to calculate a site-specific attenuation factor, such as the Johnson & Ettinger model.

In addition, MRBCA incorporates vapor intrusion screening levels based on contaminant concentrations in soil, which is not a recommended approach to assess whether the vapor intrusion pathway is complete. Most states and EPA regions do not use or encourage the use of soil-to-indoor air screening levels. EPA’s draft vapor intrusion guidance cites uncertainties related to soil partitioning calculations and analytical limitations when sampling and evaluating volatile compounds in the soil matrix which reduce the defensibility of soil screening levels. Furthermore, non-detect analytical results do not necessarily indicate a lack of a soil gas source (due to potential volatilization during sample collection, handling, and analysis). For these reasons, MDHSS recommends MRBCA no longer use soil to evaluate the vapor intrusion pathway.

Lead Models and Lead RBTLs

Applies to

- Section E.10 Target Levels for Lead

Cleanup levels for lead are calculated differently than for other chemicals. Since the toxicokinetics (the absorption, distribution, metabolism, and excretion of toxins in the body) of lead are well understood, lead is regulated based on blood lead concentration (PbB).

EPA's current health protection goal is to limit exposure to site soil lead levels so that a child would have no more than a 5% probability of exceeding a PbB level of 10 µg/dL.

To predict PbB concentration and the probability of a child's PbB level exceeding 10 µg/dL, EPA models which consider lead exposure and toxicokinetics in a receptor (a child using the *Integrated Exposure Uptake Biokinetic Model for Lead in Children* (IEUBK model) (<http://www.epa.gov/superfund/health/contaminants/lead/products.htm#ieubk>) or fetus using the *Adult Lead Methodology* (ALM) (<http://www.epa.gov/superfund/health/contaminants/lead/products.htm#alm>)) are the recommended models used to derive an exposure level that satisfies the risk reduction goal.

EPA's IEUBK model calculates the expected distribution of PbB concentrations for children between six months and seven years of age who have been exposed to lead through various sources (air, water, soil, dust, diet and *in utero* contributions from the mother), and estimates the probability that any particular child might have a PbB value over 10 µg/dL.

EPA's ALM is the methodology for assessing risks associated with non-residential adult exposures to lead in soil. For non-residential settings, the fetus has been determined to be the most sensitive receptor; therefore, the ALM focuses on estimating fetal PbB concentrations for women of child-bearing age who are exposed to lead-contaminated soils. The calculated screening level represents a cleanup goal for soil in which there is no more than a 5% probability that the PbB level of a fetus would exceed 10 µg/dL.

The current EPA RSLs for lead are 400 mg/kg for residential soil and 800 mg/kg for industrial soil calculated using the IEUBK and ALM models. MRBCA currently incorporates soil RBTLs for lead of 260 mg/kg for Residential Land Use and 660 mg/kg for Non-Residential Land Use which were previously calculated by MDHSS using the same models, but with varying exposure values.

MDHSS recommends that MRBCA retain its current values in order to remain on the conservative side for target levels of lead in our state. Our justification for recommending this is also due to the fact that recent scientific evidence has demonstrated adverse health effects at PbB concentrations below 10 µg/dL. Because of this, the Centers for Disease Control (CDC) recently lowered the reference value to 5 µg/dL. In addition, EPA is in the process of re-evaluating the existing soil lead policy to incorporate this new information; however, the release date for the updated policy is uncertain. Considering this, MDHSS believes that the RBTLs should account for this potential change.

Please note that because of greater soil exposure to construction workers, an industrial use scenario is not necessarily protective of construction workers. This is particularly true of lead where fetal exposure for a female worker will generate the lowest soil concentration. Please note that the ALM does not actually assume exposure by a pregnant worker, but rather

exposure by women of childbearing age. Because a fetus is more sensitive to the adverse effects of lead than an adult, the ALM focuses on the fetus of a worker who develops a body burden over time as a result of exposure to lead – this body burden is then available for transfer to the fetus for several years after the exposure ends. Since the ALM is designed to be protective for the most sensitive receptor, cleanup goals developed utilizing the ALM will also afford protection for male or female adult workers. Specifically, this methodology appears to be protective for lead's effect on blood pressure in adult males.

For construction worker exposure to lead, MDHSS recommends MRBCA incorporate a soil RBTL of 315 mg/kg. This value was calculated by MDHSS with the ALM using a combination of exposure values previously used by our office to calculate the target level for lead of 660 mg/kg for non-residential land use along with MRBCA values specific to construction worker exposure.

Soil to Groundwater Equations

Applies to MRBCA Equations:

- E-52 Subsurface Soil Concentrations Protective of Leaching to Groundwater
- E-53 Leaching Factor from Subsurface Soil to Groundwater
- E-56 Domenico Model: Dilution Attenuation Factor (DAF) in the Saturated Zone
- E-57 Allowable Soil and Groundwater Concentration for Groundwater Resource Protection
- E-58 Allowable Soil and Groundwater Concentration Protective of Indoor Inhalation for Resident and Non-Residential Worker

The MRBCA equations for soil leaching to groundwater are derived from ASTM. As previously indicated, MDHSS recommends that equations be updated to be consistent with EPA guidance; therefore, MDHSS recommends using the EPA equation provided in Section 4.11 of EPA's RSL User's Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm).

Soil and Soil Vapor Saturation Equations

Applies to MRBCA Equations:

- E-54 Soil Concentration at Which Dissolved Pore Water and Vapor Phases Become Saturated
- E-55 Soil Vapor Concentration at Which Vapor Phase Becomes Saturated

The MRBCA equation for soil saturation is noted to be derived from ASTM; however, this calculation appears to be essentially the same as EPAs; therefore, the only expected change would be to provide an EPA source for the calculation. The EPA equation for soil saturation is provided in Section 5.11 of EPA's RSL User's Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm).

There is another MRBCA soil saturation equation provided for multiple chemicals. MDHSS does not believe this calculation is needed for a Tier 1 risk assessment; however, the use of such an equation should be discussed for a Tier 2 or Tier 3 risk assessment.

In addition, there are also MRBCA equations for soil vapor saturation derived from ASTM for single chemicals and multiple chemicals. MDHSS does not believe these calculations are needed for a Tier 1 risk assessment; however, the use of such equations should be discussed for a Tier 2 or Tier 3 risk assessment.

Remaining MRBCA Equations

During our review of the MRBCA Equations, the following equations were identified that are based on current science and methodology; therefore, no substantial changes are anticipated:

- E-18 Dermal Contact with Chemicals in Water (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-22 Dermal Contact with Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-23 Ingestion of Chemicals in Soil (Child and Adult Resident, Non-Residential Worker, and Construction Worker)
- E-29 Dermal Contact with Chemicals in Water (Age-Adjusted Resident)
- E-34 Dermal Contact with Chemicals in Soil (Age-Adjusted Resident)
- E-36 Ingestion of Chemicals in Soil (Age-Adjusted Resident)

MRBCA EXPOSURE FACTORS

As previously stated, MDHSS recommends the DTLs and Tier 1 RBTLs be based on default EPA assumptions in order to represent conservative RME scenarios to protect public health. Recommended default exposure variables were selected by EPA to represent RME scenarios by combining average and upper-bound values.

MDHSS has reviewed the exposure factors provided in Table E-4 of the MRBCA guidance and recommends changes as described below.

- Construction Worker Averaging Time for Non-Carcinogens – MDHSS recommends that this be revised to reflect an averaging time of less than a year (126 days or .35 years). Please note that the default averaging time is typically a year or more; however, for exposures expected to occur over a shorter time interval, the exposure frequency should not be prorated over an entire year but should be averaged over the assumed duration of exposure (EPA RAGS Part A, 1989); therefore, an averaging time based on MRBCA's default exposure frequency of 90 days should be calculated as follows: construction worker is assumed to work 5 days a week on a 18-week construction project and is not on site the remainder of the year (90 day exposure frequency / 5 day workweek = 18 weeks x 7 days per week = 126 day averaging time or .35 years).
- Construction Worker Soil Ingestion Rate – MDHSS recommends that this be revised to 330 mg/day to account for soil contact intensive activities that construction workers would be engaged in to be reflective of an RME scenario (EPA Supplemental Soil Screening Guidance, 2002). The current MRBCA default soil ingestion value for construction workers is set at 100 mg/day which is only intended for workers engaged in

maintenance and moderate soil disturbing activities. This should be revised to reflect EPA's default value for construction and other high-end soil contact work.

- Inhalation Rate – MDHSS recommends that the inhalation rate values be removed from MRBCA. Pursuant to the change to EPA's inhalation equations, inhalation rate is no longer used in the equations.
- Exposure Time for Indoor/Outdoor Inhalation – MDHSS recommends that the exposure time be revised to the standard inhalation time per day and that the exposure time not apportion time between hours indoors and hours outdoors to reflect an RME scenario. EPA's default exposure time for inhalation is 24 hours/day for residents and 8 hours/day for workers (EPA RAGS Part F, 2009).
- Incidental Dermal Contact with Water – These parameters are only needed for the construction worker scenario. Dermal contact with water for children and adults is already accounted for by the whole-body dermal contact with water; therefore, the following parameters are not needed in a Tier 1 evaluation for children and adults: Skin Surface Area for Incidental Dermal Contact with Water, Event Frequency for Incidental Dermal Contact with Water, and Event Duration for Incidental Dermal Contact with Water. Dermal contact with water for non-residential workers is currently provided in the RBTL tables; however, if the domestic water use pathway is complete, then comparison should be made to residential levels for domestic use; therefore, MDHSS does not believe the groundwater dermal contact RBTLs are needed for the non-residential scenario for a Tier 1 evaluation.
- Resident Child and Adult Whole-Body Contact with Water – MDHSS recommends that the Event Duration for Whole-Body Contact with Water for children and adults be revised to 1.0 and .58 hour/event, respectively, to reflect an RME scenario (EPA RAGS Part E, 2004). The current MRBCA defaults for event duration are based on EPA exposure values for a central tendency scenario; therefore, these should be revised to reflect EPA's default values for an RME scenario.

In addition to the above changes, exposure parameters for specific equations such as the mutagenic equations will be incorporated into MRBCA as needed.

MRBCA TOXICITY VALUES

MDHSS recommends that all toxicity values be updated to reflect current science – there have been numerous updates to toxicity values over the past years and the MRBCA toxicity values are outdated and some differ substantially with current values. MDHSS recommends that the toxicity values be modified to reflect the most recent toxicity values available. Current toxicity values can be found on EPA's RSL Table (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm).

MDHSS has reviewed the sources of toxicity values provided in Table E-1 of the MRBCA guidance and recommends changes as described below.

Chemicals

Please refer to Attachment A for a listing of chemicals proposed to be included in the MRBCA update. This listing incorporates all chemicals that are currently in MRBCA along with additional chemicals that are contained in EPA's RSLs.

Toxicity Value Hierarchy

MRBCA's current toxicity value hierarchy is as follows:

- Tier 1: Integrated Risk Information System (IRIS),
- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs),
- Tier 3: Miscellaneous Sources:
 - National Center for Environmental Assessment (NCEA) as listed in USEPA's Region IX Preliminary Remediation Goal (PRG) Table,
 - California Office of Environmental Health Hazard Assessments (OEHHAs) chemical database,
 - Health Effects Assessment Summary Tables (HEAST) as listed in USEPA's Region IX PRG tables, and
 - Table for Texas Risk Reduction Program.

While this generally follows EPA's [toxicity value hierarchy](#), MDHSS proposes revising this to follow the general hierarchy used in developing the EPA RSLs as noted below:

- Tier 1: EPA's Integrated Risk Information System ([IRIS](#))
- Tier 2: EPA's Provisional Peer Reviewed Toxicity Values ([PPRTVs](#))
- Tier 3: Other Sources:
 - Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels ([MRLs](#))
 - California Environmental Protection Agency (OEHHA) Office of Environmental Health Hazard Assessment's [Chronic Reference Exposure Levels \(RELS\) and Cancer Potency Values](#)
 - Screening toxicity values provided in the appendix to certain PPRTV assessments (for the EPA RSLs these were put ahead of HEAST toxicity values because these appendix screening toxicity values are more recent and use current EPA methodologies in the derivation, and because the PPRTV appendix screening toxicity values also receive external peer review).
 - EPA's Health Effects Assessment Summary Tables ([HEAST](#))

Section 2.3 of EPA's RSL User's Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm) contains additional information on their hierarchy for toxicity values along with specific information on toxicity equivalence factors (TEFs) that apply to certain classes of chemicals.

If no toxicity values are available from these sources for the chemicals to be included in the MRBCA update, MDHSS will review other potential sources for toxicity values. In selecting specific sources, MDHSS will concentrate on the following criteria: the source provides toxicity information based on similar methods and procedures as those used by EPA, the values are peer-reviewed, are available to the public, and there is transparency about the methodology used to develop the values.

Dermal Toxicity

Because dermal toxicity values are not readily available, dermal toxicity is calculated from oral toxicity values. MRBCA incorporates an absorption factor of 1 for all chemicals (termed RAF_o in MRBCA guidance); however, this does not follow current EPA recommendations. MDHSS recommends that MRBCA be revised to follow the recommendations provided in Chapter 4 of EPA's *Risk Assessment Guidance for Superfund, Part E: Supplemental Guidance for Dermal Risk Assessment (RAGS Part E)* (<http://www.epa.gov/oswer/riskassessment/ragse/index.htm>) for chemical-specific dermal absorption factors.

Oral to Inhalation Route-to-Route Extrapolation

Due to the scarcity of inhalation toxicity factors, MRBCA incorporated generic route-to-route extrapolation from oral toxicity factors to inhalation toxicity factors when there was a lack of a chemical-specific inhalation value; however, this does not follow current EPA recommendations. EPA no longer recommends this generic route extrapolation because of the uncertainty associated with making such adjustments (e.g., point-of-entry, first-pass, and route-specific effects may not be adequately considered by simple extrapolations). EPA only recommends route extrapolations when chemical-specific issues have been considered; therefore, MDHSS recommends MRBCA be revised to no longer use the generic route extrapolation. During our update of toxicity values, if MDHSS identifies specific chemicals for which a route extrapolation is appropriate, MDHSS will incorporate route extrapolation for those identified chemicals and will highlight this on the MRBCA toxicity values table.

Surrogate Values

In case of a lack of toxicity values for a particular chemical, MDHSS may opt to use values from a surrogate chemical if appropriate and will highlight this on the MRBCA toxicity values table.

MRBCA CHEMICAL-SPECIFIC PARAMETERS

MDHSS has reviewed the sources for the parameters for the dermal exposure pathways provided in Tables E-1 and E-2 and the physical and chemical properties of chemicals provided in Table E-3 of the MRBCA guidance and recommends changes as described below.

Chemical-Specific Parameters for Dermal Exposure Pathways

There are a variety of chemical-specific parameters needed to assess soil dermal absorption and dermal contact with water pathways, such as the dermal absorption fraction from soil (termed RAF_d in MRBCA guidance) and the dermal permeability constant. MRBCA uses RAGS Part E (<http://www.epa.gov/oswer/riskassessment/ragse/index.htm>) as the main source for dermal contact parameters. However, there are a few additional sources that are used in MRBCA when values could not be found in or estimated by equations in RAGs Part E. MDHSS recommends revising this to use the hierarchy of sources provided in EPA's RSLs. RAGS Part E is the primary source used in the RSLs for the majority of the parameters; however, there are additional sources used for specific parameters such as the dermal permeability constant which is obtained from the following hierarchy: EPA's EPI program, RAGS Part E.

Physical and Chemical Properties

MRBCA currently uses an outdated hierarchy of sources for physical and chemical properties. These include:

- MDNR's Cleanup Levels for Missouri (CALM), 2001:
 - 1997 Handbook of Physical Properties of Organic Chemicals, Howard and Meylan
 - 1989 Dangerous Properties of Industrial Materials, Sax and Lewis
 - Extoxnet website, 2000
 - EPA Air Toxics website
 - EPA Region IX PRGs
- EPA Region IX PRGs InterCalc Tables, 2002
- Texas Risk Reduction Program, 2004
- Idaho Department of Environmental Quality RBCA Tables, 2003

MDHSS believes the physical and chemical parameters should be updated and specifically recommends the use of the parameters provided in EPA's RSL tables. These values are more current and EPA uses a vigorous hierarchy of sources to populate their database of physical and chemical parameters. There is actually a hierarchy of sources for each parameter; however, generally, EPA's EPI and WATER9 programs are the primary sources.

Section 2.4 of EPA's RSL User's Guide (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm) contains the complete listing of sources and the hierarchy by parameter. The table below contains an abbreviated list of the primary parameters used in EPA's calculations.

<i>Parameters</i>	<i>EPA's General Hierarchy of Sources</i>
Molecular Weight (MW) (g/mol)	EPI, CRC, Perry
Henry's Law Constant (H' and HLC) (unitless and atm-m ³ /mol)	EPI, SSL, Yaws
Diffusivity in Air (D _{ia})	WATER9, SSL

(cm ² /s)	
Diffusivity in Water (D _{iw}) (cm ² /s)	WATER9, SSL
Organic Carbon Partition Coefficient (K _{oc}) (L/kg)	EPI, SSL, Yaws
Water Solubility (S) (mg/L)	EPI, SSL, CRC, Yaws, Perry, Lange, PHYSPROP
Soil-Water Partition Coefficient (K _d) (cm ³ /g)	SSL, Baes
Sources	
Baes, 1984	Oakridge National Laboratory
CRC	Handbook of Chemistry and Physics
EPI	Estimation Programs Interface (EPI) Suite
Lange	<i>Lange's Handbook of Chemistry</i> . Speight, James G. (2005). McGraw-Hill.
Perry	<i>Perry's Chemical Engineers' Handbook</i> . Green, Don W.; Perry, Robert H. (2008). McGraw-Hill.
PHYSPROP	Syracuse Research Corporation PHYSPROP Database
SSL	EPA Soil Screening Level (SSL)
WATER9	EPA WATER9
Yaws	<i>Handbook of Thermodynamic and Physical Properties of Chemical Compounds</i> . Yaws, Carl L. (2003). Knovel.

Additionally, use of the parameters listed in the EPA RSL tables will simplify the update if the DTL & RBTL update incorporates EPA's list of chemicals, since not all of the chemicals listed in the EPA RSL tables are currently included in MRBCA.

There are a limited number of chemicals in MRBCA that are not listed in EPA's RSL table. If these chemicals will be used in updating the DTLs and RBTLs, MDHSS proposes use of EPA's hierarchy for selecting chemical and physical parameters. If all EPA sources are exhausted, DHSS will use the latest versions of other standard reference materials.

MRBCA FATE AND TRANSPORT PARAMETERS

MDHSS has reviewed the fate and transport parameters provided in Table E-5 of the MRBCA guidance. The majority of these parameters are used in ASTM equations that MDHSS does not recommend. Please refer to Attachment B for a listing of these parameters along with notations/recommendations on their use in MRBCA. In general, MDHSS recommends updating the soil type 1 values to be consistent with EPA's default values.

In addition to changes to the existing parameters, fate and transport parameters for specific equations such as for the trench model to estimate inhalation of vapors from groundwater for the construction worker will be incorporated into MRBCA as needed.

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Analytes (sorted by CAS#)	CAS#	SOURCE:
		1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Formaldehyde	000050-00-0	3
DDT	000050-29-3	3
Benzo(a)pyrene	000050-32-8	3
Dinitrophenol, 2,4-	000051-28-5	3
Urethane	000051-79-6	1
Dibenzo(a,h)anthracene	000053-70-3	3
Acetylaminofluorene, 2-	000053-96-3	1
Nitrosodiethylamine, N-	000055-18-5	1
Fenthion	000055-38-9	2
Nitroglycerin	000055-63-0	3
Carbon Tetrachloride	000056-23-5	3
Tributyltin Oxide	000056-35-9	1
Parathion	000056-38-2	3
Methylcholanthrene, 3-	000056-49-5	1
Diethylstilbestrol	000056-53-1	1
Benzo(a)anthracene	000056-55-3	3
Coumaphos	000056-72-4	2
Cyanide	000057-12-5	3
Dimethylhydrazine, 1,1-	000057-14-7	1
Strychnine	000057-24-9	3
Propylene Glycol	000057-55-6	1
Chlordane, gamma	000057-74-9	2
Dimethylbenz(a)anthracene, 7,12-	000057-97-6	1
Hexachlorocyclohexane, Gamma- (Lindane)	000058-89-9	3
Tetrachlorophenol, 2,3,4,6-	000058-90-2	1
Cresol, p-chloro-m-	000059-50-7	1
Nitrofurazone	000059-87-0	1
Nitrosomorpholine [N-]	000059-89-2	1
Dimethylamino azobenzene [p-]	000060-11-7	1
Ethyl Ether	000060-29-7	1
Methyl Hydrazine	000060-34-4	1
Dimethoate	000060-51-5	3
Dieldrin	000060-57-1	3
Phenylmercuric acetate	000062-38-4	3
Phenacetin	000062-44-2	1
Aniline	000062-53-3	3
Dichlorvos	000062-73-7	1
Sodium Fluoroacetate	000062-74-8	1
Nitrosodimethylamine, N-	000062-75-9	3
Carbaryl	000063-25-2	3
Ethanol	000064-17-5	2
Formic Acid	000064-18-6	1
Benzoic Acid	000065-85-0	3
Methyl methanesulfonate	000066-27-3	1
Nitrofurantoin	000067-20-9	1
Furazolidone	000067-45-8	1
Methanol	000067-56-1	3
Isopropanol	000067-63-0	1
Acetone	000067-64-1	3
Chloroform	000067-66-3	3
Hexachloroethane	000067-72-1	3
Dimethylformamide	000068-12-2	1
Methyl-N-nitro-N-nitrosoguanidine, N-	000070-25-7	1
Hexachlorophene	000070-30-4	3

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Butanol, N-	0000071-36-3	1
Benzene	0000071-43-2	3
Trichloroethane, 1,1,1-	0000071-55-6	3
Endrin	0000072-20-8	3
Methoxychlor	0000072-43-5	3
DDD	0000072-54-8	3
DDE	0000072-55-9	3
Chlorobenzoic Acid, p-	0000074-11-3	1
Diphenyl-1,4-benzenediamine, N,N'	0000074-31-7	1
Bromomethane	0000074-83-9	3
Chloromethane	0000074-87-3	3
Methyl iodide	0000074-88-4	2
Hydrogen Cyanide	0000074-90-8	1
Dibromomethane (Methylene Bromide)	0000074-95-3	1
Bromochloromethane	0000074-97-5	3
Ethyl Chloride	0000075-00-3	3
Vinyl Chloride	0000075-01-4	3
Acetonitrile	0000075-05-8	3
Acetaldehyde	0000075-07-0	1
Methylene chloride	0000075-09-2	3
Carbon Disulfide	0000075-15-0	3
Ethylene Oxide	0000075-21-8	1
Bromoform	0000075-25-2	3
Bromodichloromethane	0000075-27-4	3
Dichloroethane, 1,1-	0000075-34-3	3
Dichloroethylene, 1,1-	0000075-35-4	3
Difluoroethane, 1,1-	0000075-37-6	1
Phosgene	0000075-44-5	1
Chlorodifluoromethane	0000075-45-6	1
Nitromethane	0000075-52-5	1
Propylene Oxide	0000075-56-9	1
Cacodylic Acid	0000075-60-5	1
Tertiary-butyl-alcohol (TBA)	0000075-65-0	2
Chloro-1,1-difluoroethane, 1-	0000075-68-3	1
Trichlorofluoromethane	0000075-69-4	3
Dichlorodifluoromethane	0000075-71-8	3
Acetone Cyanohydrin	0000075-86-5	1
Dalapon	0000075-99-0	3
Pentachloroethane	0000076-01-7	1
Trichloroacetic Acid	0000076-03-9	1
Chloropicrin	0000076-06-2	1
Trichlorotrifluoroethane, 1,1,2-	0000076-13-1	3
Heptachlor	0000076-44-8	3
Hexachlorocyclopentadiene	0000077-47-4	3
Dicyclopentadiene	0000077-73-6	1
Tetraethyl Lead	0000078-00-2	1
Pentaerythritol tetranitrate (PETN)	0000078-11-5	3
Tris(2-ethylhexyl)phosphate	0000078-42-2	1
Merphos Oxide	0000078-48-8	3
Isophorone	0000078-59-1	3
Isobutyl Alcohol	0000078-83-1	1
Dichloropropane, 1,2-	0000078-87-5	3
Butyl alcohol, sec-	0000078-92-2	1
Methyl Ethyl Ketone (2-Butanone)	0000078-93-3	3

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Trichloroethane, 1,1,2-	0000079-00-5	3
Trichloroethylene	0000079-01-6	3
Acrylamide	0000079-06-1	3
Acrylic Acid	0000079-10-7	3
Chloroacetic Acid	0000079-11-8	1
Methyl Acetate	0000079-20-9	1
Tetrachloroethane, 1,1,2,2-	0000079-34-5	3
Dichloroacetic Acid	0000079-43-6	1
Nitropropane, 2-	0000079-46-9	1
Bisphenol A	0000080-05-7	1
Sulfonylbis(4-chlorobenzene), 1,1'-	0000080-07-9	1
Methyl Methacrylate	0000080-62-6	1
Warfarin	0000081-81-2	3
Pentachloronitrobenzene	0000082-68-8	3
Acenaphthene	0000083-32-9	3
Rotenone	0000083-79-4	1
Anthraquinone, 9,10-	0000084-65-1	1
Diethyl Phthalate	0000084-66-2	3
Ethylphthalyl Ethyl Glycolate	0000084-72-0	1
Dibutyl Phthalate	0000084-74-2	3
Diquat	0000085-00-7	3
Phenanthrene	0000085-01-8	2
Phthalic Anhydride	0000085-44-9	1
Butyl Benzyl Phthlate	0000085-68-7	3
Butylphthalyl Butylglycolate	0000085-70-1	1
Nitrosodiphenylamine, n-	0000086-30-6	3
Guthion	0000086-50-0	3
Fluorene	0000086-73-7	3
Carbazole	0000086-74-8	2
Trichlorobenzene, 1,2,3-	0000087-61-6	1
Hexachlorobutadiene	0000087-68-3	3
Hexabromobenzene	0000087-82-1	1
Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	0000087-84-3	1
Pentachlorophenol	0000087-86-5	3
Trichlorophenol, 2,4,6-	0000088-06-2	3
Nitrotoluene, 2-	0000088-72-2	3
Chloronitrobenzene, o-	0000088-73-3	1
Nitroaniline, 2-	0000088-74-4	3
Nitrophenol, 2-	0000088-75-5	2
Dinitro-6-sec-butylphenol, 2,4- (Dinoseb)	0000088-85-7	3
Methylnaphthalene, 1-	0000090-12-0	1
Phenylphenol, 2-	0000090-43-7	1
Dichlorobenzophenone, 4,4'-	0000090-98-2	1
Naphthalene	0000091-20-3	3
Quinoline	0000091-22-5	1
Methylnaphthalene, 2-	0000091-57-6	3
Chloronaphthalene, 2-	0000091-58-7	3
Naphthylamine, 2-	0000091-59-8	1
Dichlorobenzidine, 3,3-	0000091-94-1	3
Biphenyl, 1,1-	0000092-52-4	3
Aminobiphenyl, 4-	0000092-67-1	1
Phenothiazine	0000092-84-2	1
Benzidine	0000092-87-5	3
MCPP	0000093-65-2	3

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Silvex (2,4,5-TP)	000093-72-1	3
Trichlorophenoxy acetic acid, 2,4,5- (2,4,5-T)	000093-76-5	3
Dihydrosafrole	000094-58-6	1
Safrole	000094-59-7	1
Methyl-4-chlorophenoxyacetic acid, 2- (MCPA)	000094-74-6	3
Dichlorophenoxy acetic acid, 2,4- (2,4-D)	000094-75-7	3
MCPB	000094-81-5	1
Butyric acid, 4-(2,4-Dichlorophenoxy) (2,4-DB)	000094-82-6	3
Xylene, o-	000095-47-6	1
Methylphenol, 2-	000095-48-7	3
Chlorotoluene, 2-	000095-49-8	3
Dichlorobenzene, 1,2-	000095-50-1	3
Phenylenediamine, o-	000095-54-5	1
Chlorophenol, 2-	000095-57-8	3
Trimethylbenzene, 1,2,4-	000095-63-6	3
Dimethylphenol, 3,4-	000095-65-8	1
Dimethylaniline, 2,4-	000095-68-1	1
Chloro-2-methylaniline, 4-	000095-69-2	1
Toluene-2,5-diamine	000095-70-5	1
Tetrachlorobenzene, 1,2,4,5-	000095-94-3	3
Trichlorophenol, 2,4,5-	000095-95-4	3
Dibromo-3-chloropropane, 1,2-	000096-12-8	3
Trichloropropane, 1,2,3-	000096-18-4	3
Trichloropropene, 1,2,3-	000096-19-5	1
Methyl Acrylate	000096-33-3	1
Ethylene Thiourea	000096-45-7	3
Picramic Acid (2-Amino-4,6-dinitrophenol)	000096-91-3	1
Ethyl Methacrylate	000097-63-2	1
Furfural	000098-01-1	1
Butylbenzene, tert-	000098-06-6	3
Benzotrichloride	000098-07-7	1
Chlorobenzotrifluoride, 4-	000098-56-6	1
Cumene	000098-82-8	3
Methylstyrene, Alpha-	000098-83-9	1
Acetophenone	000098-86-2	1
Nitrobenzene	000098-95-3	3
Nitrotoluene, 3-	000099-08-1	3
Nitroaniline, 3-	000099-09-2	2
Trinitrobenzene, 1,3,5-	000099-35-4	3
Methyl-5-Nitroaniline, 2-	000099-55-8	1
Methoxy-5-nitroaniline, 2-	000099-59-2	1
Dinitrobenzene, 1,3-	000099-65-0	3
Isopropyltoluene, 4-	000099-87-6	3
Nitrotoluene, 4-	000099-99-0	3
Chloronitrobenzene, p-	000100-00-5	1
Nitroaniline, 4-	000100-01-6	3
Nitrophenol, 4-	000100-02-7	2
Phthalic Acid, P-	000100-21-0	1
Dinitrobenzene, 1,4-	000100-25-4	1
Ethylbenzene	000100-41-4	3
Styrene	000100-42-5	3
Benzyl Chloride	000100-44-7	1
Benzyl Alcohol	000100-51-6	3
Benzaldehyde	000100-52-7	1

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Monomethylaniline	0000100-61-8	1
Nitrosopiperidine [N-]	0000100-75-4	1
Methylene-bis(2-chloroaniline), 4,4'-	0000101-14-4	1
Chlorpropham	0000101-21-3	1
Bromophenyl phenyl ether, 4-	0000101-55-3	2
Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	0000101-61-1	1
Methylenediphenyl Diisocyanate	0000101-68-8	1
Methylenebisbenzenamine, 4,4'-	0000101-77-9	1
Triacetin	0000102-76-1	1
Di(2-ethylhexyl)adipate	0000103-23-1	3
Azobenzene	0000103-33-3	3
Propylbenzene, n-	0000103-65-1	3
Butylbenzene, n-	0000104-51-8	3
Caprolactam	0000105-60-2	1
Dimethylphenol, 2,4-	0000105-67-9	3
Dibromobenzene, 1,4-	0000106-37-6	1
Xylene, p-	0000106-42-3	1
Chlorotoluene, p-	0000106-43-4	3
Cresol, p-	0000106-44-5	3
Dichlorobenzene, 1,4-	0000106-46-7	3
Chloroaniline, p-	0000106-47-8	3
Toluidine, p-	0000106-49-0	1
Phenylenediamine, p-	0000106-50-3	1
Epoxybutane, 1,2-	0000106-88-7	1
Epichlorohydrin	0000106-89-8	1
Dibromoethane, 1,2-	0000106-93-4	3
Butadiene, 1,3-	0000106-99-0	1
Acrolein	0000107-02-8	3
Bromo-2-chloroethane, 1-	0000107-04-0	1
Allyl Chloride	0000107-05-1	3
Dichloroethane, 1,2-	0000107-06-2	3
Chloroethanol, 2-	0000107-07-3	1
Acrylonitrile	0000107-13-1	3
Ethylene Diamine	0000107-15-3	1
Allyl Alcohol	0000107-18-6	3
Propargyl Alcohol	0000107-19-7	1
Chloroacetaldehyde, 2-	0000107-20-0	1
Ethylene Glycol	0000107-21-1	3
Chloromethyl Methyl Ether	0000107-30-2	1
Propylene Glycol Monomethyl Ether	0000107-98-2	1
Vinyl Acetate	0000108-05-4	1
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	0000108-10-1	3
Diisopropyl Ether	0000108-20-3	3
Maleic anhydride	0000108-31-6	3
Xylene, m-	0000108-38-3	1
Cresol, m-	0000108-39-4	3
Phenylenediamine, m-	0000108-45-2	3
Bis(2-chloro-1-methylethyl) ether	0000108-60-1	3
Trimethylbenzene, 1,3,5-	0000108-67-8	3
Trichlorobenzene, 1,3,5-	0000108-70-3	2
Bromobenzene	0000108-86-1	1
Toluene	0000108-88-3	3
Chlorobenzene	0000108-90-7	3
Cyclohexylamine	0000108-91-8	1

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Cyclohexanone	0000108-94-1	1
Phenol	0000108-95-2	3
Benzenethiol	0000108-98-5	1
Pentane, n-	0000109-66-0	1
Chlorobutane, 1-	0000109-69-3	1
Malononitrile	0000109-77-3	1
Ethylene Cyanohydrin	0000109-78-4	1
Methoxyethanol, 2-	0000109-86-4	1
Tetrahydrofuran	0000109-99-9	3
Furan	0000110-00-9	1
Methoxyethanol Acetate, 2-	0000110-49-6	1
Hexane, n-	0000110-54-3	3
Dichloro-2-butene, trans-1,4-	0000110-57-6	1
Ethoxyethanol, 2-	0000110-80-5	1
Cyclohexane	0000110-82-7	1
Cyclohexene	0000110-83-8	1
Pyridine	0000110-86-1	1
Ethoxyethanol Acetate, 2-	0000111-15-9	1
Glutaraldehyde	0000111-30-8	1
Diethanolamine	0000111-42-2	1
Bis(2-chloroethyl)ether	0000111-44-4	3
Thiodiglycol	0000111-48-8	1
Adiponitrile	0000111-69-3	1
Ethylene Glycol Monobutyl Ether	0000111-76-2	1
Nonane, n-	0000111-84-2	1
Diethylene Glycol Monoethyl Ether	0000111-90-0	1
Bis(2-chloroethoxy)methane	0000111-91-1	1
Diethylene Glycol Monobutyl Ether	0000112-34-5	1
Baygon	0000114-26-1	3
Propylene	0000115-07-1	1
Endosulfan	0000115-29-7	3
Tris(2-chloroethyl)phosphate	0000115-96-8	1
Aldicarb	0000116-06-3	3
Bis(2-ethylhexyl)phthalate	0000117-81-7	3
Di-n-octylphthalate	0000117-84-0	3
Hexachlorobenzene	0000118-74-1	3
Chloranil	0000118-75-2	1
Trinitrotoluene, 2,4,6-	0000118-96-7	3
Dimethoxybenzidine, 3,3'-	0000119-90-4	1
Dimethylbenzidine, 3,3'-	0000119-93-7	1
Anthracene	0000120-12-7	3
Dichloroprop (2,4-DP)	0000120-36-5	2
Dimethylterephthalate	0000120-61-6	1
Trichlorobenzene, 1,2,4-	0000120-82-1	3
Dichlorophenol, 2,4-	0000120-83-2	3
Dinitrotoluene, 2,4-	0000121-14-2	3
Triethylamine	0000121-44-8	1
Dimethylaniline, N,N-	0000121-69-7	1
Malathion	0000121-75-5	3
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	0000121-82-4	3
Simazine	0000122-34-9	3
Diphenylamine	0000122-39-4	3
Propham	0000122-42-9	3
Diphenylhydrazine, 1,2-	0000122-66-7	3

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Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Aminophenol, p-	0000123-30-8	1
Hydroquinone	0000123-31-9	1
Maleic Hydrazide	0000123-33-1	3
Propionaldehyde	0000123-38-6	1
Crotonaldehyde, trans-	0000123-73-9	1
Dioxane, 1,4-	0000123-91-1	3
Hexanedioic Acid	0000124-04-9	1
Dibromochloromethane	0000124-48-1	3
Methylarsonic acid	0000124-58-3	1
Sulfolane	0000126-33-0	1
Triethylphosphorothioate, o,o,o-	0000126-68-1	2
Tributyl Phosphate	0000126-73-8	1
Methacrylonitrile	0000126-98-7	1
Chloro-1,3-butadiene, 2-	0000126-99-8	1
Tetrachloroethylene	0000127-18-4	3
Diphenyl Sulfone	0000127-63-9	1
Pyrene	0000129-00-0	3
Dimethyl phthalate	0000131-11-3	2
Dinitro-o-cyclohexyl Phenol, 4,6-	0000131-89-5	1
Dibenzofuran	0000132-64-9	3
Captan	0000133-06-2	3
Folpet	0000133-07-3	1
Chloramben	0000133-90-4	3
Cupferron	0000135-20-6	1
Butylbenzene, sec-	0000135-98-8	3
Thiram	0000137-26-8	1
Propazine	0000139-40-2	3
Aramite	0000140-57-8	1
Ethyl Acrylate	0000140-88-5	1
Bidrin	0000141-66-2	1
Ethyl Acetate	0000141-78-6	1
Dichloropropane, 1,3-	0000142-28-9	1
Cyanide (as Sodium Cyanide)	0000143-33-9	3
Chlordecone (Kepone)	0000143-50-0	1
Endothall	0000145-73-3	3
Sodium Diethyldithiocarbamate	0000148-18-5	1
Merphos	0000150-50-5	1
Potassium Cyanide	0000151-50-8	1
Ethyleneimine	0000151-56-4	1
Octamethylpyrophosphoramidate	0000152-16-9	1
Dichloroethylene, 1,2-cis-	0000156-59-2	3
Dichloroethylene, trans-1,2-	0000156-60-5	3
Benzo(g,h,i)perylene	0000191-24-2	2
Dibenzo(a,e)pyrene	0000192-65-4	1
Indeno(1,2,3-cd)pyrene	0000193-39-5	3
Benzo(j)fluoranthene	0000205-82-3	1
Benzo(b)fluoranthene	0000205-99-2	3
Fluoranthene	0000206-44-0	3
Benzo(k)fluoranthene	0000207-08-9	3
Acenaphthylene	0000208-96-8	2
Chrysene	0000218-01-9	3
Methyl Parathion	0000298-00-0	3
Phorate	0000298-02-2	3
Disulfoton	0000298-04-4	3

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Ronnel	0000299-84-3	1
Naled	0000300-76-5	3
Lead acetate	0000301-04-2	1
Hydrazine	0000302-01-2	1
Chloral Hydrate	0000302-17-0	1
Aldrin	0000309-00-2	3
Hexachlorocyclohexane, Alpha-	0000319-84-6	3
Hexachlorocyclohexane, Beta-	0000319-85-7	3
delta-Hexachlorocyclohexane	0000319-86-8	3
Diuron	0000330-54-1	3
Linuron	0000330-55-2	1
Diazinon	0000333-41-5	3
Cyanogen	0000460-19-5	1
Thiocyanic Acid	0000463-56-9	1
Chlorfenvinphos	0000470-90-6	1
Methyl-2,4,6-trinitrophenylnitramine	0000479-45-8	3
Auramine	0000492-80-8	1
Dithiane, 1,4-	0000505-29-3	1
Potassium Silver Cyanide	0000506-61-6	1
Silver Cyanide	0000506-64-9	1
Cyanogen bromide	0000506-68-3	3
Cyanogen Chloride	0000506-77-4	1
Chlorobenzilate	0000510-15-6	1
Trimethyl Phosphate	0000512-56-1	1
Dimethylvinylchloride	0000513-37-1	1
Trimethylbenzene, 1,2,3-	0000526-73-8	1
Dinitrobenzene, 1,2-	0000528-29-0	1
Furium	0000531-82-8	1
Chloroacetophenone, 2-	0000532-27-4	1
Dinitro-o-cresol, 4,6-	0000534-52-1	3
Dichloroethylene, 1,2- (Mixed Isomers)	0000540-59-0	1
Dimethylhydrazine, 1,2-	0000540-73-8	1
Dichlorobenzene, 1,3-	0000541-73-1	2
Dichloropropene, 1,3-	0000542-75-6	3
Bis(chloromethyl)ether	0000542-88-1	3
Copper Cyanide	0000544-92-3	1
Nitroguanidine	0000556-88-7	1
Zinc Cyanide	0000557-21-1	1
Ethion	0000563-12-2	1
Thallium Acetate	0000563-68-8	1
Dimethylphenol, 2,6-	0000576-26-1	3
Aminophenol, m-	0000591-27-5	1
Methyl butyl ketone	0000591-78-6	3
Calcium Cyanide	0000592-01-8	1
Vinyl Bromide	0000593-60-2	1
Trichloropropane, 1,1,2-	0000598-77-6	1
Dinitrotoluene, 2,6-	0000606-20-2	3
Hexachlorocyclohexane, Technical	0000608-73-1	1
Pentachlorobenzene	0000608-93-5	3
Methyl-1,4-benzenediamine dihydrochloride, 2-	0000615-45-2	1
Methylbenzene-1,4-diamine sulfate, 2-	0000615-50-9	1
Tribromobenzene, 1,2,4-	0000615-54-3	1
Dichloropropanol, 2,3-	0000616-23-9	1
Diethylformamide	0000617-84-5	1

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Nitroso-di-N-propylamine, N-	0000621-64-7	3
Methyl Isocyanate	0000624-83-9	1
Tetrachloroethane, 1,1,1,2-	0000630-20-6	3
Trichloroaniline, 2,4,6-	0000634-93-5	1
Methylaniline Hydrochloride, 2-	0000636-21-5	1
Ethyl-tert-butyl-ether (ETBE)	0000637-92-3	2
Hexamethylphosphoramide	0000680-31-9	1
Nitroso-N-methylurea, N-	0000684-93-5	1
Tri-n-butyltin	0000688-73-3	1
Propanil	0000709-98-8	3
Phosmet	0000732-11-6	1
Dimethyl methylphosphonate	0000756-79-6	1
Nitroso-N-ethylurea, N-	0000759-73-9	1
Eptam	0000759-94-4	3
Dichloro-2-butene, 1,4-	0000764-41-0	1
Glycidyl	0000765-34-4	1
Triphenylphosphine Oxide	0000791-28-6	1
Tetrafluoroethane, 1,1,1,2-	0000811-97-2	1
Hexamethylene Diisocyanate, 1,6-	0000822-06-0	1
Ametryn	0000834-12-8	3
Terbutryn	0000886-50-0	3
Nitroso-di-N-butylamine, N-	0000924-16-3	1
Nitrosopyrrolidine, n-	0000930-55-2	3
Fonofos	0000944-22-9	3
Mephosfolan	0000950-10-7	1
Methidathion	0000950-37-8	1
Diphenamid	0000957-51-7	1
Stirofos (Tetrachlorovinphos)	0000961-11-5	1
Methyl Phosphonic Acid	0000993-13-5	1
Tertiary-amyl-methyl-ether (TAME)	0000994-05-8	2
Heptachlor epoxide	0001024-57-3	3
Glyphosate	0001071-83-6	3
Pebulate	0001114-71-2	1
Nitrosodiethanolamine, N-	0001116-54-7	1
Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	0001163-19-5	1
Ceric oxide	0001306-38-3	1
Antimony Trioxide	0001309-64-4	1
Nickel Oxide	0001313-99-1	1
Antimony Pentoxide	0001314-60-9	1
Vanadium Pentoxide	0001314-62-1	1
Zinc Phosphide	0001314-84-7	1
Cresols	0001319-77-3	1
Xylenes	0001330-20-7	3
Tricresyl Phosphate (TCP)	0001330-78-5	1
Antimony Tetroxide	0001332-81-6	1
Lead subacetate	0001335-32-6	1
Polychlorinated biphenyls (PCBs)	0001336-36-3	3
Diisopropyl Methylphosphonate	0001445-75-6	1
Dichloro-2-butene, cis-1,4-	0001476-11-5	1
Carbofuran	0001563-66-2	3
Propylene Glycol Monoethyl Ether	0001569-02-4	1
Trifluralin	0001582-09-8	3
ALAR	0001596-84-5	1
Prometon	0001610-18-0	3

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Methyl tert-Butyl Ether (MTBE)	0001634-04-4	3
Aldicarb sulfoxide	0001646-87-3	1
Aldicarb sulfone	0001646-88-4	3
Bromoxynil	0001689-84-5	1
Bromoxynil Octanoate	0001689-99-2	1
TCDD, 2,3,7,8-	0001746-01-6	1
Isopropyl Methyl Phosphonic Acid	0001832-54-8	1
Dacthal	0001861-32-1	3
Benefin	0001861-40-1	1
Chlorothalonil	0001897-45-6	3
Paraquat Dichloride	0001910-42-5	1
Atrazine	0001912-24-9	3
Dicamba	0001918-00-9	3
Picloram	0001918-02-1	3
Propachlor	0001918-16-7	3
Vernolate	0001929-77-7	1
Direct Black 38	0001937-37-7	1
Butylate	0002008-41-5	3
Ethyl-p-nitrophenyl Phosphonate	0002104-64-5	1
Bromophos	0002104-96-3	1
Fluometuron	0002164-17-2	3
Molinate	0002212-67-1	1
Diallate	0002303-16-4	1
Triallate	0002303-17-5	3
Propargite	0002312-35-8	1
Mirex	0002385-85-5	3
Captafol	0002425-06-1	1
Dodine	0002439-10-3	1
Direct Blue 6	0002602-46-2	1
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetra (HMX)	0002691-41-0	3
Chlorpyrifos	0002921-88-2	3
Chloro-2-methylaniline HCl, 4-	0003165-93-3	1
Asulam	0003337-71-1	1
Temephos	0003383-96-8	1
Tetraethyl Dithiopyrophosphate	0003689-24-5	1
Paraquat	0004685-14-7	2
Tetrachlorotoluene, p- alpha, alpha, alpha-	0005216-25-1	1
Carboxin	0005234-68-4	3
Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	0005436-43-1	1
Chlorpyrifos Methyl	0005598-13-0	1
Terbacil	0005902-51-2	3
Benzenediamine-2-methyl sulfate, 1,4-	0006369-59-1	1
Propylene Glycol Dinitrate	0006423-43-4	1
Thallium Carbonate	0006533-73-9	1
Chlorophenyl phenyl ether, 4-	0007005-72-3	2
Prometryn	0007287-19-6	1
Tetrapotassium phosphate	0007320-34-5	1
Endrin aldehyde	0007421-93-4	2
Aluminum	0007429-90-5	3
Iron	0007439-89-6	1
Lead	0007439-92-1	3
Lithium	0007439-93-2	1
Manganese	0007439-96-5	3
Mercury	0007439-97-6	3

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Molybdenum	0007439-98-7	3
Nickel	0007440-02-0	3
Silver	0007440-22-4	3
Strontium	0007440-24-6	3
Thallium (Soluble Salts)	0007440-28-0	1
Tin	0007440-31-5	1
Antimony	0007440-36-0	3
Arsenic	0007440-38-2	3
Barium	0007440-39-3	3
Beryllium	0007440-41-7	3
Boron And Borates Only	0007440-42-8	1
Cadmium	0007440-43-9	3
Chromium, Total	0007440-47-3	3
Cobalt	0007440-48-4	1
Copper	0007440-50-8	3
Vanadium	0007440-62-2	3
Zinc	0007440-66-6	3
Zirconium	0007440-67-7	1
Thallium Sulfate	0007446-18-6	1
Selenium Sulfide	0007446-34-6	1
Mercuric Chloride (and other Mercury salts)	0007487-94-7	1
Titanium Tetrachloride	0007550-45-0	1
Iodine	0007553-56-2	1
Disodium phosphate	0007558-79-4	1
Monosodium phosphate	0007558-80-7	1
Trisodium phosphate	0007601-54-9	1
Sodium Perchlorate	0007601-89-0	1
Silica (crystalline, respirable)	0007631-86-9	1
Boron Trifluoride	0007637-07-2	1
Hydrogen Chloride	0007647-01-0	1
Phosphoric Acid	0007664-38-2	1
Hydrogen Fluoride	0007664-39-3	1
Ammonia	0007664-41-7	3
Sulfuric Acid	0007664-93-9	1
Sodium Fluoride	0007681-49-4	3
Monoammonium phosphate	0007722-76-1	1
Tetrasodium pyrophosphate	0007722-88-5	1
Phosphorus, White	0007723-14-0	3
Monomagnesium phosphate	0007757-86-0	1
Trimagnesium phosphate	0007757-87-1	1
Dicalcium phosphate	0007757-93-9	1
Dipotassium phosphate	0007758-11-4	1
Sodium acid pyrophosphate	0007758-16-9	1
Chlorite (Sodium Salt)	0007758-19-2	1
Monocalcium phosphate	0007758-23-8	1
Sodium tripolyphosphate	0007758-29-4	1
Tricalcium phosphate	0007758-87-4	1
Ammonium Sulfamate	0007773-06-0	1
Tripotassium phosphate	0007778-53-2	1
Potassium Perchlorate	0007778-74-7	1
Monopotassium phosphate	0007778-77-0	1
Fluorine (Soluble Fluoride)	0007782-41-4	1
Selenium	0007782-49-2	3
Chlorine	0007782-50-5	1

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Dimagnesium phosphate	0007782-75-4	1
Selenious Acid	0007783-00-8	1
Hydrogen Sulfide	0007783-06-4	1
Diammonium phosphate	0007783-28-0	1
Arsine	0007784-42-1	1
Sodium trimetaphosphate	0007785-84-4	1
Sodium aluminum phosphate (acidic)	0007785-88-8	1
Calcium pyrophosphate	0007790-76-3	1
Ammonium Perchlorate	0007790-98-9	1
Lithium Perchlorate	0007791-03-9	1
Thallium Chloride	0007791-12-0	3
Phosphine	0007803-51-2	1
Toxaphene	0008001-35-2	3
Coke Oven Emissions	0008007-45-2	1
Mineral oils	0008012-95-1	1
Polyphosphoric acid	0008017-16-1	1
Mancozeb	0008018-01-7	1
Demeton	0008065-48-3	3
Nitrocellulose	0009004-70-0	1
Polymeric Methylene Diphenyl Diisocyanate (PMDI)	0009016-87-9	1
Hydrazine Sulfate	0010034-93-2	1
Chlorine Dioxide	0010049-04-4	1
Thallium (I) Nitrate	0010102-45-1	1
Sodium hexametaphosphate	0010124-56-8	1
Methamidophos	0010265-92-6	1
Sodium aluminum phosphate (anhydrous)	0010279-59-1	1
Boron Trichloride	0010294-34-5	1
Sodium aluminum phosphate (tetrahydrate)	0010305-76-7	1
Resmethrin	0010453-86-8	1
Nitrosomethylethylamine, N-	0010595-95-6	1
Monochloramine	0010599-90-3	1
Antimony Potassium Tartrate	0011071-15-1	1
Aroclor 1260	0011096-82-5	3
Aroclor 1254	0011097-69-1	3
Aroclor 1221	0011104-28-2	3
Aroclor 1232	0011141-16-5	1
Nickel Subsulfide	0012035-72-2	1
Zineb	0012122-67-7	1
Maneb	0012427-38-2	3
Aroclor 1248	0012672-29-6	3
Aroclor 1016	0012674-11-2	3
Chlordane	0012789-03-6	3
Terbufos	0013071-79-9	3
Ethoprop	0013194-48-4	2
Nickel Carbonyl	0013463-39-3	1
Monoaluminum phosphate	0013530-50-2	1
Quinalphos	0013593-03-8	1
Tris(1-chloro-2-propyl)phosphate	0013674-84-5	1
Tris(1,3-Dichloro-2-propyl) Phosphate	0013674-87-8	1
Phenmedipham	0013684-63-4	1
Sodium Metavanadate	0013718-26-8	1
Aluminum metaphosphate	0013776-88-0	1
Potassium tripolyphosphate	0013845-36-8	1
Nitrate	0014797-55-8	1

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Nitrite	0014797-65-0	1
Perchlorate	0014797-73-0	3
Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	0015136-87-5	1
Napropamide	0015299-99-7	1
Bromate	0015541-45-4	1
Alachlor	0015972-60-8	3
Chromium(III), Insoluble Salts	0016065-83-1	1
Direct Brown 95	0016071-86-6	1
Ethephon	0016672-87-0	1
Methomyl	0016752-77-5	3
Fluoride	0016984-48-8	1
Benomyl	0017804-35-2	1
Chromium(VI)	0018540-29-9	3
Oryzalin	0019044-88-3	1
Dinitrotoluene, 4-Amino-2,6-	0019406-51-0	3
Oxadiazon	0019666-30-9	1
Aluminum Phosphide	0020859-73-8	1
Metribuzin	0021087-64-9	3
Dimethylaniline HCl, 2,4-	0021436-96-4	1
TCMTB	0021564-17-0	1
Cyanazine	0021725-46-2	3
Fenamiphos	0022224-92-6	3
Methyl Mercury	0022967-92-6	1
Oxamyl	0023135-22-0	3
Thiophanate, Methyl	0023564-05-8	1
Pronamide	0023950-58-5	3
Mepiquat Chloride	0024307-26-4	1
Methyl Styrene (Mixed Isomers)	0025013-15-4	1
Butylated hydroxyanisole	0025013-16-5	1
Bentazon	0025057-89-0	1
Dinitrotoluene, Technical grade	0025321-14-6	1
Profluralin	0026399-36-0	1
Sodium Azide	0026628-22-8	1
Norflurazon	0027314-13-2	1
Thiobencarb	0028249-77-6	1
Pirimiphos, Methyl	0029232-93-7	1
Acephate	0030560-19-1	1
Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	0031508-00-6	1
Pentabromodiphenyl Ether	0032534-81-9	1
Octabromodiphenyl Ether	0032536-52-0	1
Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	0032598-13-3	1
Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	0032598-14-4	1
Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	0032774-16-6	1
Amitraz	0033089-61-1	1
Trichloroaniline HCl, 2,4,6-	0033663-50-2	1
Isopropalin	0033820-53-0	1
Tebuthiuron	0034014-18-1	3
Acetochlor	0034256-82-1	3
Difflubenzuron	0035367-38-5	1
Imazalil	0035554-44-0	1
Dinitrotoluene, 2-Amino-4,6-	0035572-78-2	3
Iprodione	0036734-19-7	1
Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	0038380-08-4	1
Fosetyl-AL	0039148-24-8	1

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Thiofanox	0039196-18-4	1
Fenpropathrin	0039515-41-8	1
Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	0039635-31-9	1
Pendimethalin	0040487-42-1	3
Bifenox	0042576-02-3	1
Goal	0042874-03-3	1
Bayleton	0043121-43-3	1
Difenzoquat	0043222-48-6	1
Vinclozolin	0050471-44-8	1
Metolachlor	0051218-45-2	3
Pydrin	0051630-58-1	1
Cypermethrin	0052315-07-8	1
Permethrin	0052645-53-1	1
Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	0052663-72-6	1
Aroclor 1242	0053469-21-9	3
Endrin ketone	0053494-70-5	2
Chlorozotocin	0054749-90-5	1
Carbosulfan	0055285-14-8	1
Dimethipin	0055290-64-7	1
Flurprimidol	0056425-91-3	1
Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	0057465-28-8	1
Nitropyrene, 4-	0057835-92-4	1
Metalaxyl	0057837-19-1	1
Tridiphane	0058138-08-2	1
Polybrominated Biphenyls	0059536-65-1	1
Fluridone	0059756-60-4	1
Propiconazole	0060207-90-1	1
Chlorthiophos	0060238-56-4	1
Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	0060348-60-9	1
Furmecyclox	0060568-05-0	1
Sodium Acifluorfen	0062476-59-9	3
Naphtha, High Flash Aromatic (HFAN)	0064724-95-6	1
Chlorsulfuron	0064902-72-3	1
Avermectin B1	0065195-55-3	1
Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	0065510-44-3	1
Cyromazine	0066215-27-8	1
Flutolanil	0066332-96-5	1
Tralomethrin	0066841-25-6	1
Amdro	0067485-29-4	1
Prochloraz	0067747-09-5	1
Cyhalothrin/karate	0068085-85-8	1
Ammonium polyphosphate	0068333-79-9	1
Baythroid	0068359-37-5	1
Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	0068631-49-2	1
Sodium polyphosphate	0068915-31-1	1
Fluvalinate	0069409-94-5	1
Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	0069782-90-7	1
Haloxypop, Methyl	0069806-40-2	1
Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	0070362-50-4	1
Fomesafen	0072178-02-0	1
Sethoxydim	0074051-80-2	1
Apollo	0074115-24-5	1
Ally	0074223-64-6	1
Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	0074472-37-0	1

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ATTACHMENT A**

Analytes (sorted by CAS#)	CAS#	SOURCE: 1=Listed in EPA only; 2=Listed in MRBCA only; 3=Listed in both EPA & MRBCA
Methylbenzene,1-4-diamine monohydrochloride, 2-	0074612-12-7	1
Assure	0076578-14-8	1
Paclobutrazol	0076738-62-0	1
Glufosinate, Ammonium	0077182-82-2	1
Lactofen	0077501-63-4	1
Savey	0078587-05-0	1
Harmony	0079277-27-3	1
Imazaquin	0081335-37-7	1
Pursuit	0081335-77-5	1
Triasulfuron	0082097-50-5	1
Isoxaben	0082558-50-7	1
Biphenhrin	0082657-04-3	1
Londax	0083055-99-6	1
Nustar	0085509-19-9	1
Sythane	0088671-89-0	1
Chlorimuron, Ethyl-	0090982-32-4	1
Express	0101200-48-0	1
Hexazinone	5001235-04-2	3
Dibutyltin Compounds	NA	1
Diesel Engine Exhaust	NA	1
Dinitrotoluene Mixture, 2,4/2,6-	NA	1
Hexachlorodibenzo-p-dioxin, Mixture	NA	1
JP-7	NA	1
Nickel Refinery Dust	NA	1
Nitrate + Nitrite (as N)	NA	1
Refractory Ceramic Fibers	NA	1
Thiocyanates	NA	1
Tributyltin Compounds	NA	1
Uranium (Soluble Salts)	NA	1
Aliphatics - > C6-C8 (TPH-GRO)	NA	2
Aliphatics - > C8-C10 (TPH-GRO)	NA	2
Aliphatics - >C10-C12 (TPH-DRO)	NA	2
Aliphatics - >C12-C16 (TPH-DRO)	NA	2
Aliphatics - >C16-C21 (TPH-DRO)	NA	2
Aliphatics - >C21-C35 TPH-ORO)	NA	2
Aromatics - >C10-C12 (TPH-DRO)	NA	2
Aromatics - >C12-C16 (TPH-DRO)	NA	2
Aromatics - >C16-C21 (TPH-DRO)	NA	2
Aromatics - >C21-C35 (TPH-ORO)	NA	2
Aromatics - >C8-C10 (TPH-GRO)	NA	2
TPH-DRO	NA	2
TPH-GRO	NA	2
TPH-ORO	NA	2

EPA	486
MRBCA	40
EPA & MRBCA	273
TOTAL COUNT	799

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ATTACHMENT B

**MRBCA DTL RBTL Update - MDHSS Project Proposal
ATTACHMENT B**

Parameters	Transport Impacted	Factor	Formula Source/Use
Soil Parameters			
Soil Source Dimension Parallel to Wind Direction (W_a), cm	VFss Surface soil to outdoor air.		Used in alternative formula for VFss - not applicable at Tier 1.
Depth to Subsurface Soil Sources (d_{ts}), cm	VFsesp Subsurface soil to indoor air.		Formula not recommended.
Depth of Surficial Soil Zone (d_s), cm	VFss Surface soil to outdoor air.		Used in alternative formula for VFss - not applicable at Tier 1.
Depth to Soil Vapor Measurement (d_{sv}), cm	VFsv Subsurface soil vapor to indoor air.		Formula not recommended.
Vadose Zone			
Total Soil Porosity (θ_T), cm^3/cm^3 -soil	VFss Surface soil to outdoor air, Dseff effective diffusion for vapor phase, and Dcapeff for capillary fringe.	0.38	VFss applicable. Other formulae not recommended. EPA uses 0.43
Volumetric Water Content (θ_{ws}), cm^3/cm^3	VFss, VFsv, VFsesp, Dseff, CsSAT	0.08	VFss and soil saturation applicable. Other formulae not recommended. EPA uses 0.15.
Volumetric Air Content (θ_{as}), cm^3/cm^3	VFss, VFsv, VFsesp, Dseff, LFsw, CsSAT	0.3	VFss and soil saturation applicable. Other formulae not recommended. EPA uses 0.28.
Thickness (h_v), cm	Dwseff Effective diffusion coefficients for groundwater to outdoor air		Formula not recommended.
Dry Soil Bulk Density (ρ_s), g/cm^3	VFss, VFsesp, LFsw, CsSAT	1.5	VFss, leaching to groundwater, and soil saturation applicable. Other formula not recommended. Same as EPA.
Fractional Organic Carbon Content (f_{ocv}), g-C/g-soil	CsSAT, LFsw, VFsesp.	0.006	Leaching to groundwater and soil saturation applicable. Other formula not recommended. EPA uses 0.002 for leaching to groundwater and 0.006 for soil saturation.
Soil In Cracks			
Total Soil Porosity (θ_{Tcrack}), cm^3/cm^3 -soil	VI equations		Formula not recommended.
Volumetric Water Content (θ_{wcrack}), cm^3/cm^3	VI equations		Formula not recommended.
Volumetric Air Content (θ_{acrack}), cm^3/cm^3	VI equations		Formula not recommended.
Capillary Fringe			
Total Soil Porosity (θ_{Tcap}), cm^3/cm^3 -soil	Impacts groundwater to outdoor air VF through Dwseff		Formula not recommended.
Volumetric Water Content (θ_{wcap}), cm^3/cm^3	Impacts groundwater to outdoor air VF through Dwseff		Formula not recommended.
Volumetric Air Content (θ_{acap}), cm^3/cm^3	Impacts groundwater to outdoor air VF through Dwseff		Formula not recommended.
Thickness (h_c), cm	Impacts groundwater to outdoor air VF through Dwseff		Formula not recommended.
Groundwater Parameters			
Depth to Groundwater (L_{gw}), cm	VFwesp, VFwamb, and Dwseff		Formula not recommended.
GW Source Dimension Perpendicular to GW Flow Direction (Y), cm	Domenico Model		Formula not recommended.
GW Source Dimension Parallel to GW Flow Direction (W_{ga}), cm	Leaching and VF-GW to outdoor air.	1500	Leaching to groundwater applicable. Other formula not recommended. EPA uses default DAF.
Total Porosity in the Saturated Zone (θ_{TS}), cm^3/cm^3	Groundwater resource protection (GRP)		Formula not recommended.
Dry Soil Bulk Density (Saturated Zone) (ρ_{ss}), g/cm^3	GRP		Formula not recommended.

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ATTACHMENT B**

Fractional Organic Carbon Content in the Saturated Zone (f_{ocs}), g-C/g-soil	GRP		Formula not recommended.
Groundwater Mixing Zone Thickness (δ_{gw}), cm	LFsw	200	Leaching to groundwater applicable. Other formula not recommended. EPA uses default DAF.
Hydraulic Conductivity in the Saturated Zone (K), cm/year	LFsw and GRP	625000	Leaching to groundwater applicable. Other formula not recommended. EPA uses default DAF.
Hydraulic Gradient in the Saturated Zone (i), cm/cm	LFsw and GRP	0.004	Leaching to groundwater applicable. Other formula not recommended. EPA uses default DAF.
Groundwater Darcy Velocity (U_{gw}), cm/year	LFsw and Qgw (Stream Protection)	2500	Leaching to groundwater applicable. Other formula not considered in this review. EPA uses default DAF.
Infiltration Rate of Water Through Vadose Zone (I), cm/year	LFsw	14	Modify LFsw to EPA model. EPA uses default DAF.
Ambient Air Parameters			
Breathing Zone Height (δ_a), cm	VFss and VFwamb		Used in alternative formula for VFss - not applicable at Tier 1.
Inverse of Mean Concentration at Center of Square Source (Q/C), ($g/m^2-s)/(kg/m^3$)	VFss and VFp	81.64	EPA RSL uses 93.77 for VF and 68.81 for PEF.
Fraction of Vegetative Cover (V), m^2/m^2	VFss and VFp	0.5	Same as EPA.
Mean Annual Wind Speed (U_m), m/s	VFss, VFp, VFwamb	4.69	VFss and VFp applicable. Other formula not recommended. Same as EPA.
Equivalent Threshold Value of Windspeed (U_t), m/s	VFp	11.32	Same as EPA.
Windspeed Distribution from Cowherd et. al. 1985 (Fx), unitless	VFp	0.194	Same as EPA.
Enclosed Space Parameters			
Enclosed Space Air Exchange Rate:			
Residential Structure (ER), 1/24 hours	VI equations		Formula not recommended.
Non-Residential Structure (ER), 1/24 hours	VI equations		Formula not recommended.
Enclosed Space Volume/Infiltration Area:			
Residential Structure (L_B), cm	VI equations		Formula not recommended.
Non-Residential Structure (L_B), cm	VI equations		Formula not recommended.
Volatilization Factor for Domestic Water Use (K), L/m^3	Domestic Water Use equations	0.5	Same as EPA. Andelman Volatilization Factor.
Enclosed Space Foundation or Wall Thickness:			
Residential Structure (L_{crack}), cm	VI equations		Formula not recommended.
Non-Residential Structure (L_{crack}), cm	VI equations		Formula not recommended.
Area Fraction of Cracks in Foundation/Walls:			
Residential Structure (n), cm^2/cm^2	VI equations		Formula not recommended.
Non-Residential Structure (n), cm^2/cm^2	VI equations		Formula not recommended.