Technical Support Document:

Recommended Numeric Criteria for Common Additional Polluting Substances and Certain Alternative Criteria

September 20, 2018

Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127 www.ct.gov/deep
Commissioner Robert Klee

Table of Contents

Background and Scope of Project

In 1996, the Connecticut Department of Energy and Environmental Protection (CTDEEP) adopted the Remediation Standard Regulations (RSRs) (CTDEEP 2013) that established the requirements for the remediation of contaminated sites within Connecticut. The regulations included risk-based criteria which identified acceptable concentrations of contaminants at remediation sites within the state. Numeric criteria for 88 substances were provided for soil, groundwater, and soil vapor.

Since 1996, however, substances for which remediation criteria were not established within the RSRs, typically referred to as Additional Polluting Substances, have been identified at remediation sites, necessitating the development of site-specific remediation criteria by site managers. Also, alternative site-specific criteria requests have been proposed to CTDEEP using the alternative criteria provisions of the RSRs. In both cases, the development of site-specific criteria was needed so that remedial activities could be properly planned and site cleanup goals identified and implemented. Case by case approval by CTDEEP of these additional or alternative criteria is needed as the necessary criteria were not currently available in the RSRs. New or revised criteria cannot be included in the regulations until a regulatory adoption process is completed to amend the regulations with new criteria values.

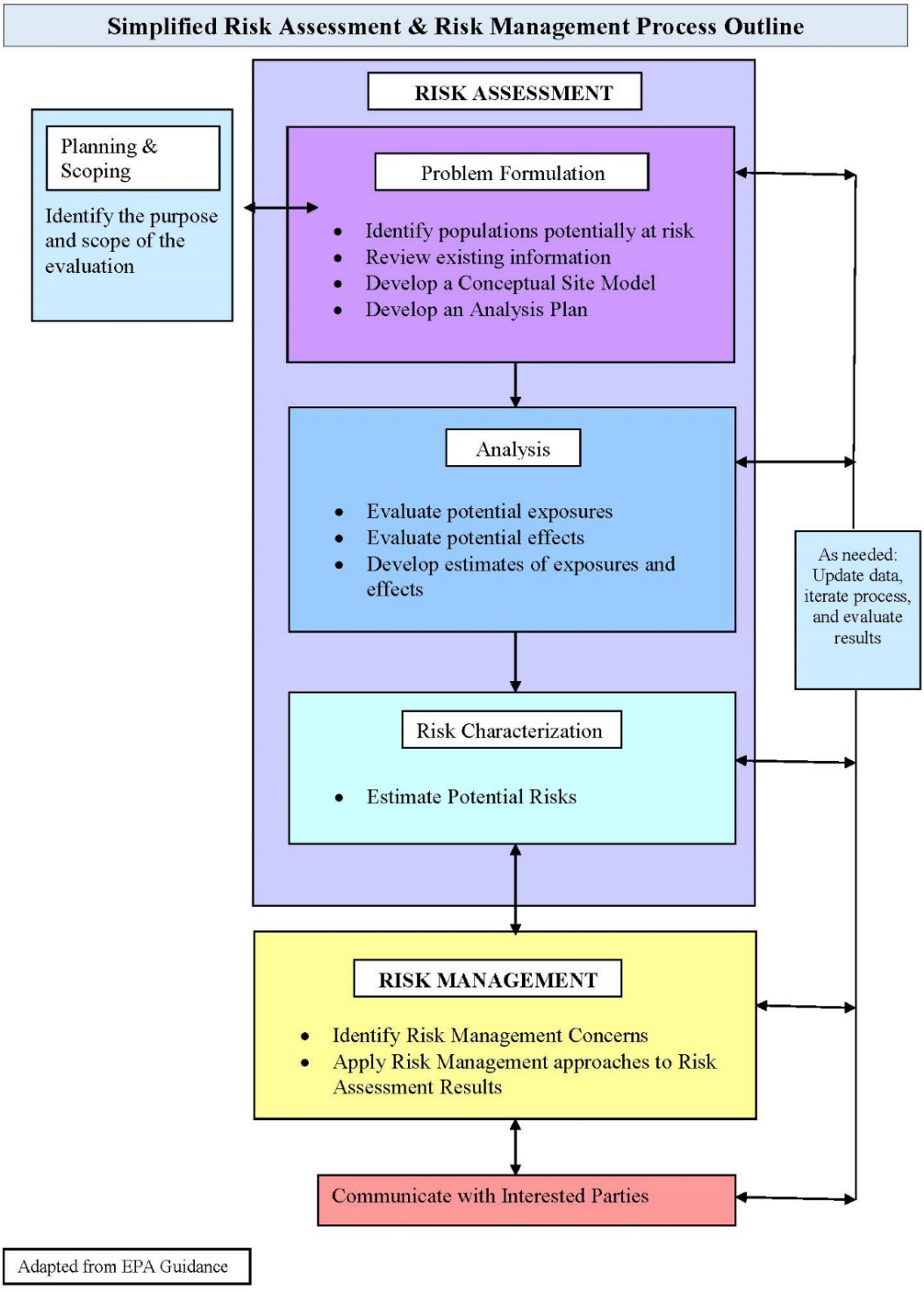
As part of the CTDEEP Risk-Based Decision Making Recommendations Report (CTDEEP 2015) developed pursuant to the process established by Public Act 13-308, CTDEEP committed to evaluating and updating remediation criteria in the RSRs. However, this process will take some time. In the meantime, the Department recognizes that case by case development of remediation criteria will need to continue until the criteria review and updating process is completed and a regulatory process accomplished.

To facilitate remedial activities at sites where such additional or alternative criteria are needed, and to reduce the potential impact of criteria derivation on project timelines, the CTDEEP, in consultation with the Connecticut Department of Public Health (CTDPH), has prepared a set of recommended remediation criteria for common substances for which Additional Polluting Substance Criteria or Alternative Criteria have been requested to supplement the criteria identified in the existing remediation regulations. These recommended remediation criteria are derived using the same risk assessment and risk management processes which were used for previous criteria development under the RSRs and are consistent with the EPA approaches to human and ecological risk assessment (Figure 1).

Use of the recommended remediation criteria is voluntary. Site managers may choose to use these criteria or elect to derive their own site-specific criteria in accordance with existing regulatory provisions. Use of the recommended criteria is expected to be a more efficient process for site managers, as there would not be the need to develop site-specific criteria with associated documentation for review and approval, which would take some time given the complexity of these submittals.

CTDEEP has developed an expedited process for issuing approvals to use these recommended criteria. This expedited process and the necessary submittal forms are available on the CTDEEP website at http://www.ct.gov/deep/cwp/view.asp?a=2715&q=484634&deepNav_GID=1626. Site managers may elect to derive Alternative Criteria or criteria for Additional Polluting Substances that differ from those proposed within this document. Any such proposals will be reviewed by CTDEEP and CTDPH, as appropriate, for potential approval on a site by site basis in accordance with the RSRs.

Figure 1.

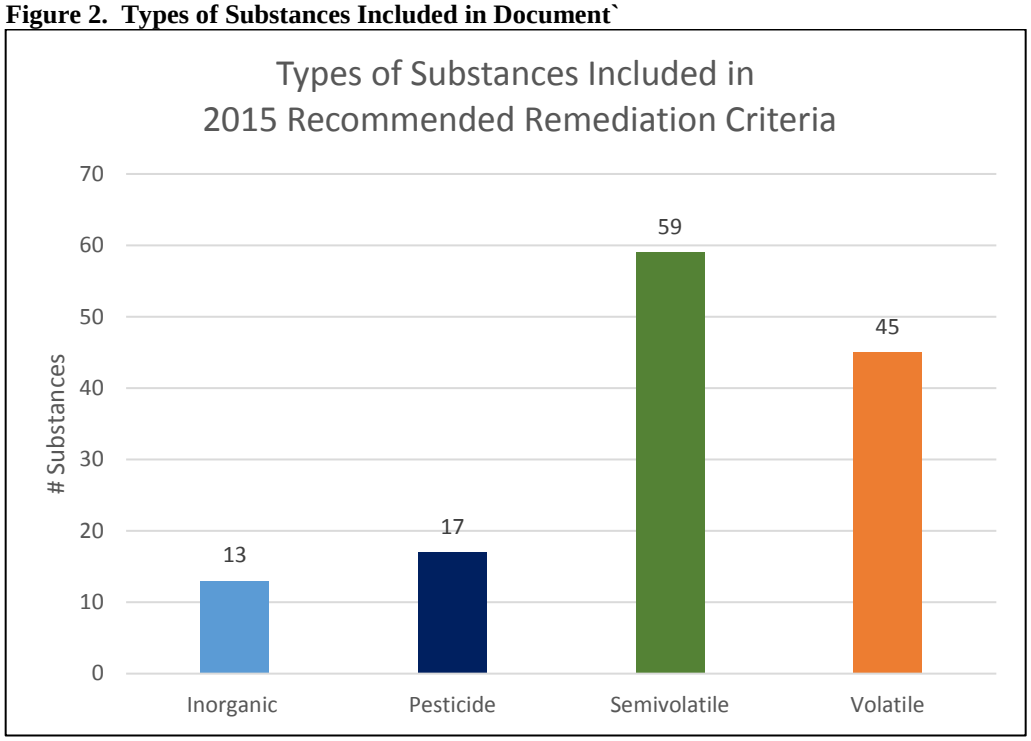

Simplified Risk Assessment & Risk Management Process Outline
RISK ASSESSMENT
Planning & Scoping
Identify the purpose and scope of the evaluation
Problem Formulation
Identify populations potentially at risk
Review existing information
Develop a Conceptual Site Model
Develop an Analysis Plan
Analysis
Evaluate potential exposures
Evaluate potential effects
Develop estimates of exposures and effects
Risk Characterization
Estimate Potential Risks
As needed: Update data, iterate process, and evaluate results
RISK MANAGEMENT
Identify Risk Management Concerns
Apply Risk Management approaches to Risk Assessment Results
Communicate with Interested Parties
Adapted from EPA Guidance

Approach to Criteria Derivation

Problem Formulation

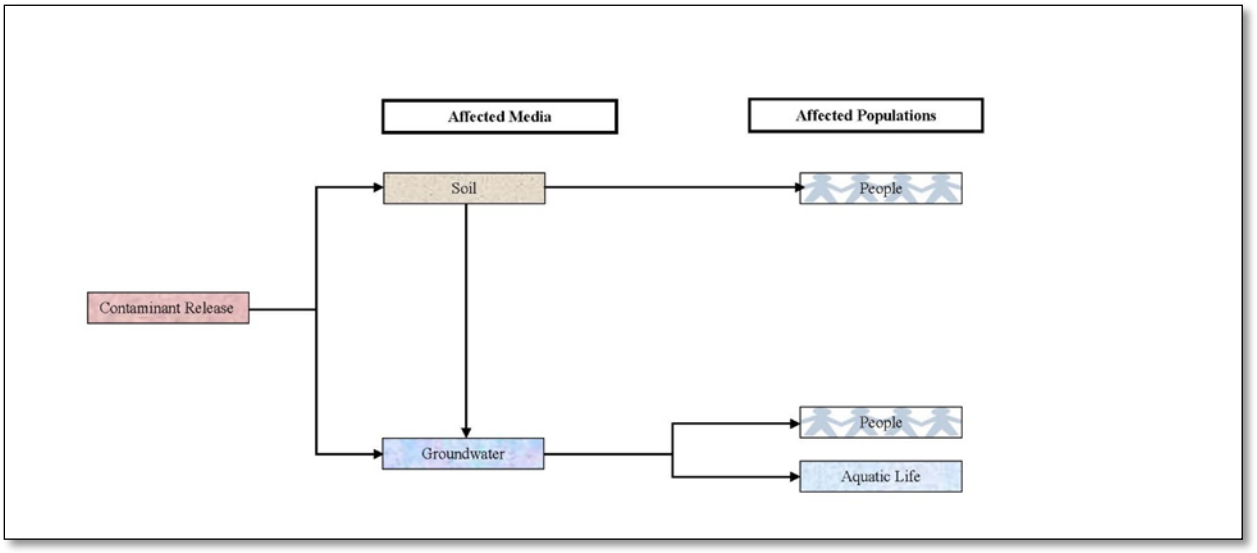
Risk-based criteria are derived using data and assumptions to define those potentially exposed to contaminated environmental media, the rate at which the exposure may occur, and the toxicity of the substance. Requests for approval of site-specific remediation criteria were reviewed and gaps in coverage of current RSR criteria were evaluated, which resulted in the identification of 134 substances for development of recommended remediation criteria (Figure 2).

Figure 2. Types of Substances Included in Document`



The recommended remediation criteria were derived using the same Conceptual Site Model that forms the foundation of the current RSR criteria. The model identifies that releases of substances to soil or groundwater could impact people through direct contact (ingestion) with soil or groundwater or through exposures resulting from volatilization of groundwater contamination. The model also identifies the potential for impacts to aquatic life through the discharge of groundwater to surface water bodies (Figure 3).

Figure 3. Conceptual Site Model for 1996 RSR Criteria



Analysis of Exposures and Effects

Exposure

The recommended remediation criteria are based on the assumption that people may be exposed to substances released at remediation sites. Following the conceptual site model established to support derivation of the current RSR criteria, criteria for people were developed for two typical exposure groups: people within residential settings and workers in an industrial/commercial settings. Within a residential setting, it was assumed that both adults and children would be present. For the industrial/commercial setting, it was assumed that only working adults would be exposed to site contamination. Exposure calculations for these receptors used upper bound but realistic estimates of contact rates with affected media, following the EPA Risk Assessment Guidance for Superfund (USEPA 1989). The same exposure assumptions as used in the RSR criteria and 2003 draft volatilization criteria (CTDEEP 2003) were used to derive the recommended remediation criteria.

Criteria were also derived to establish acceptable risk-based concentrations for groundwater plumes which may discharge to surface waters and impact aquatic life or people through consumption of fish exposed to site-related substances. The current Connecticut Water Quality Standards and criteria are based on the EPA methodology and exposure assumptions for derivation of human health criteria published in 2000. Exposures to aquatic populations similarly follow the EPA exposure assumptions and methods for derivation of aquatic life criteria.

Exposure Scenarios

Environmental Exposure Media	Criteria Type	Setting	Exposed Population	Exposure Pathways & Route
Soil	Direct Exposure	Residential	Adults & Children	Ingestion through exposures from direct contact with soil
		Industrial Commercial	Adults	
	Pollutant Mobility	GA	Adults	Soil contamination is transferred to groundwater which can then be ingested
		GB	Adults	
Groundwater	Groundwater Protection	GAA, GA and other groundwater used as a drinking water source	Adults	Direct ingestion
	Groundwater Volatilization	Residential	Adults & Children	Contaminants in groundwater transfer into Indoor Air resulting in inhalation exposures
		Industrial Commercial	Adults	
	Soil Vapor Volatilization	Residential	Adults & Children	Contaminants in soil vapor transfer into Indoor Air resulting in inhalation exposures
		Industrial Commercial	Adults	
Surface Water	Surface Water Protection	All groundwaters	Adults	Groundwater contaminants transfer to surface water where contaminants can accumulate in fish tissue. People are exposed through eating fish.
			Aquatic Life	Groundwater contaminants transfer to surface water where fish can be directly exposed.

Effects: Toxicity Values

Human Health

The toxicity portion of the RSR equations for risks to human health involves the use of potency values such as reference doses (RfDs) for noncarcinogenic substances or cancer slope factors (CSFs) for carcinogenic substances. The potency values condense a large amount of toxicity dose response information into a single number from which cleanup criteria can be calculated. Of the substances included in this document, two-thirds are noncarcinogenic while one third are evaluated as carcinogens. A summary of recommended toxicity values are presented in Table 1.

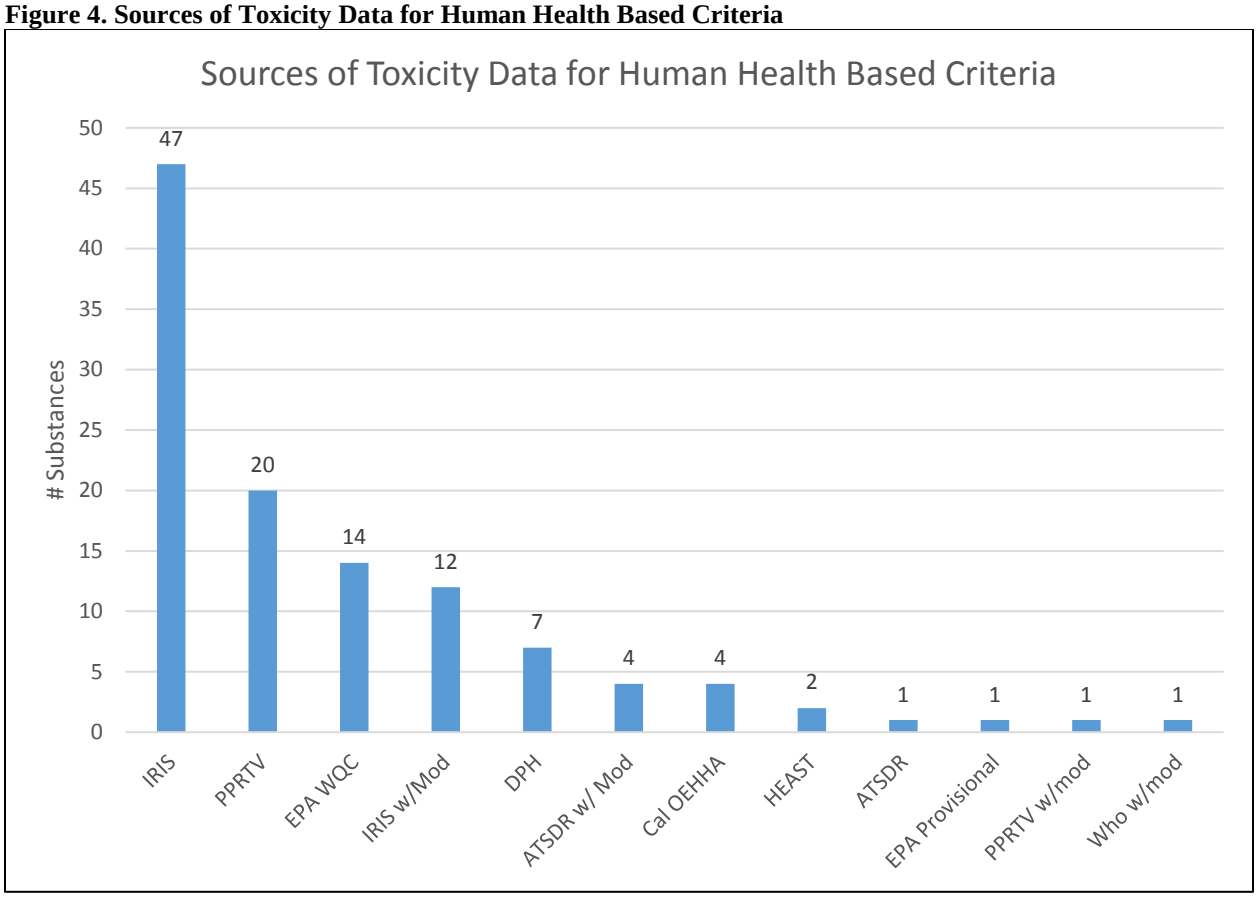
While many toxicity values are available from USEPA's Integrated Risk Information System (IRIS) (USEPA 2015a), there are numerous substances that have not yet been reviewed on IRIS. Fortunately, there are high quality sources of toxicity values in addition to IRIS, most prominently being the Agency For Toxic Substances and Disease Registry's (ATSDR's) Minimum Risk Levels (MRLs) (ATSDR 2015), California EPA's (CalEPA) Reference Exposure Levels (RELs) for non-cancer effects and CalEPA's cancer potency values (these values are used to support California's drinking water Public Health Goals and other programs) (CAL OEHHA 2015). USEPA's Superfund Office has established a program to evaluate chemicals that appear at waste sites, which the IRIS program has not had the opportunity to review. That evaluation yields provisional peer-reviewed toxicity values (PPRTVs) (USEPA 2015b), which, while not as extensively reviewed and documented as IRIS, still has clear documentation and follows USEPA IRIS methodology. Finally, there are Health Effects Assessment Summary Table (HEAST) values, which provide RfDs and CSFs for a large number of chemicals evaluated by USEPA in the 1980s and 1990s. These values were documented by USEPA until the late 1990s at which time the HEAST program was terminated and there was no further attempt to update HEAST. However, for some chemicals, the only toxicity determination can be found on HEAST (USEPA 2015c).

CTDPH evaluated the array of human health-based toxicity information available for a particular substance and selected among the choices mentioned above. Since IRIS has been a highly regarded source for many years, this remains the primary point of reference. Additionally, the toxicity values published by EPA in support of their 2015 update to the human health-based water quality criteria were also considered a primary point of reference (USEPA 2015d). However, the IRIS system has not been updated on a regular basis and numerous IRIS files have been superseded by more recent and robust analyses by other authoritative sources. Therefore, CTDPH selected from among the toxicity values available from USEPA/IRIS, USEPA/PPRTV, ATSDR, CalEPA and, to help fill data gaps, HEAST. CTDPH does not have a set hierarchy of preferred values after IRIS but prioritizes values based upon those that are most recent, best documented and supported by peer review, and which follow standardized RfD and CSF methodologies. If a value exists on IRIS and alternative values are available from other sources, CTDPH only considers these other sources if they differ from IRIS by more than threefold. Non-IRIS values may be chosen if they rely upon more recent toxicology data or represent a stronger analysis (care in evaluation of the underlying studies, inclusion of additional endpoints, consideration of uncertainties, extrapolation methods used). With respect to toxicity values for non-cancer endpoints (RfDs, MRLs, RELs), CTDPH reviewed the derivation to see if it

adequately took into account data gaps and database uncertainties: i.e., whether there are substantial data gaps for routine non-cancer testing (subchronic, chronic, developmental, reproductive), data gaps for specialty non-cancer testing that may be pertinent to a given chemical (e.g., endocrine effects, immune effects, neurodevelopmental effects), and data gaps with respect to cancer and genetic toxicology testing.

RfDs, MRLs and RELs do not attempt to account for potential carcinogenicity as cancer and non-cancer assessments are typically kept separate. However, in the final risk characterization phase, there can be considerable uncertainty associated with possible carcinogens (USEPA former Group C or International Agency for Research on Cancer (IARC) Group 3) and known animal carcinogens without cancer slope factors (USEPA Group B2 or IARC Group 2B) (IARC 2015). Specifically, the RfD-based cleanup target is often orders of magnitude higher than a cancer slope factor-based cleanup target. For chemicals that have some evidence of carcinogenic and/or mutagenic activity but have not been adequately tested, there is the possibility that the chemical is a carcinogen that would require more stringent cleanup criteria if there were better long-term testing. In such cases, an additional threefold or tenfold uncertainty factor has been applied.

Figure 4. Sources of Toxicity Data for Human Health Based Criteria



Seventy-eight percent (78%) of the recommended toxicity values were obtained directly from published sources. For the remaining 22%, either adjustments to published toxicity values are recommended or the value was derived directly by CTDPH.

Monographs have been provided in Appendix A to document toxicity values. These monographs describe the available toxicity information and value selection for 52 substances. This is not the entire list of substances included in this document. Monographs were not provided when the selection process for toxicity values was straightforward and documentation of the value could easily be found on the EPA or CTDEEP websites. Substances for which monographs were not provided include those for which the toxicity value was obtained directly from the EPA IRIS database without modification or the 2015 EPA recommended human health-based water quality criteria.

Additional monographs were not provided for the various petroleum hydrocarbon fractions as documentation of the recommended toxicity values for these substances are presented separately in the Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document (CTDEEP 2012).

Aquatic Life

Toxicity information was obtained from the EPA ECOTOX database (USEPA 2015e) and the Pesticide Action Network Pesticide Database (PAN 2015). Toxicity information was reviewed for chemicals for which a calculated aquatic life water quality criterion was either not available from EPA or another state or, if new information was available, to supersede published criteria from other states. Toxicity information for aquatic life is included in Appendix B for chemicals for which CTDEEP calculated aquatic life water quality criteria.

Risk Characterization: Calculation of Risk-Based Environmental Criteria

Direct Exposure Criteria

Direct Exposure Benchmarks are designed to establish health-protective concentrations of constituents in soil assuming that people may be exposed to such chemicals through incidental ingestion of soil. Other pathways such as absorption across the skin from dermal contact, inhalation of soil particulates, and ingestion of produce grown on affected soil were not included in the exposure estimates, although these pathways may be appropriately considered through site specific risk assessment. The recommended remediation benchmark values for direct exposure were calculated using the equations and assumptions used to derive the Direct Exposure Criteria in the 1996 Remediation Standard Regulations. The derivation of the recommended Direct Exposure Criteria is presented in Tables 2 and 3.

Residential Risk-based Direct Exposure Criteria Formulas

For substances that are non-carcinogenic:

$$\text{Res } DEC_{RB} = \frac{RfD \times HI}{\frac{IRc \times EDc \times EF \times CF}{BWc \times ATc} + \frac{IRa \times EDa \times EF \times CF}{BWa \times ATa}}$$

For substances that are carcinogenic:

$$\text{Res } DEC_{RB} = \frac{(RL / CSF)}{\frac{IRc \times EDc \times EF \times CF}{BWc \times AT} + \frac{IRa \times EDa \times EF \times CF}{BWa \times AT}}$$

Where:

Variable	Description	Value	Units
AT	Averaging Time – Carcinogen	25,550	days
ATa	Averaging Time – Adult Non-carcinogen	8760	days
ATc	Averaging Time – Child Non-carcinogen	2190	days
BWa	Body Weight – Adult	70	kg
BWc	Body Weight – Child	15	kg
CF	Conversion Factor	0.000001	kg/mg
CSF	Cancer Slope Factor	chemical specific	1/mg/kg/d
DEC_{RB}	Direct Exposure Criteria – Risk-based	chemical specific	mg/kg
EDa	Exposure Duration – Adult Non-carcinogen	24	years
EDc	Exposure Duration – Child Non-Carcinogen	6	years
EF	Exposure Frequency	365	days/year
HI	Hazard Index	1	unitless
IRa	Ingestion Rate – Adult	100	mg/day
IRc	Ingestion Rate – Child	200	mg/day
RfD	Reference Dose	chemical specific	mg/kg/d
RL	Risk Level	0.000001	unitless

Simplified Formulas:

Substance Type	Residential DEC
Non-carcinogen	67,741.935 x RfD
Carcinogen	0.6125 / CSF

Industrial/Commercial Risk-based Direct Exposure Criteria Formulas

For substances that are non-carcinogenic:

$$I/C\ DEC_{RB} = \frac{RfD \times HI \times BW \times ATnc}{IR \times EF \times ED \times CF}$$

For substances that are carcinogenic:

$$I/C\ DEC_{RB} = (RL / CSF) \times \frac{BW \times AT}{IR \times ED \times EF \times CF}$$

Where:

Variable	Description	Value	Units
AT	Averaging Time – Carcinogen	25550	days
ATnc	Averaging Time –Non-carcinogen	9125	days
BW	Body Weight – Adult	70	kg
CF	Conversion Factor	0.000001	kg/mg
CSF	Cancer Slope Factor	chemical specific	1/mg/kg/d
DEC_{RB}	Direct Exposure Criteria – Risk-based	chemical specific	mg/kg
ED	Exposure Duration	25	years
EF	Exposure Frequency	250	days/year
HI	Hazard Index	1	unitless
IR	Ingestion Rate	50	mg/day
RfD	Reference Dose	chemical specific	mg/kg/d

Simplified Formulas:

Substance Type	Industrial/Commercial DEC
Non-carcinogen	2,044,000 x RfD
Carcinogen	5.7232 / CSF

Pollutant Mobility Criteria

Contaminants in soil can be transferred to and impact ground water resources. Pollutant Mobility Criteria were developed to identify contaminant concentrations in soil which would not be expected to unacceptably impact ground water. The Pollutant Mobility Criteria were based on Groundwater Protection Criteria (GWPC).

Pollutant Mobility Criteria were calculated using the equations used to derive the Pollutant Mobility Criteria in the RSRs. For use in GA areas, GWPC were multiplied by a factor of 20 which is based on the dilution applied during the analytical methods for leaching procedures, (SPLP or TCLP) and a unit conversion factor to adjust from micrograms (units from the groundwater values) to milligrams (units from the pollutant mobility criteria). For GB areas, an additional dilution factor of 10 is included in the derivation process.

For inorganic chemicals, compliance with the Pollutant Mobility Criteria is based directly on the analytical results from leaching based analytical methods (SPLP or TCLP). Therefore, in GA areas, Pollutant Mobility Criteria for inorganic chemicals are based on multiplying the GWPC by a unit conversion factor to adjust from micrograms (units from the groundwater values) to milligrams (units from the pollutant mobility values). For GB areas, an additional dilution factor of 10 is included in the derivation process.

The derivation of the recommended Pollutant Mobility Criteria is presented in Table 4.

Pollutant Mobility Criteria Derivation:

Organic Compounds
PMCga mg/kg = GWPC ug/L x CF x AAF
PMCgb mg/kg = GWPC ug/L x CF x AAF x DF

Inorganic Compounds:
PMCga mg/l = GWPC ug/L x CF
PMCgb mg/l = GWPC ug/L x CF x DF

Where:

Variable	**Description**	**Value**	**Units**
AAF	Analytical Adjustment Factors	20	unitless
CF	Conversion Factor	0.001	mg/ug
DF	Dilution Factor	10	unitless
GWPC	Groundwater Protection Criteria	chemical specific	ug/L
PMC	Pollutant Mobility Criteria	chemical specific	mg/kg or mg/L

Pollutant Mobility Criteria Simplified Formulas

GA Areas:
Organic Chemicals: PMC (mg/kg) = GWPC x 0.02
Inorganic Chemicals: PMC (mg/L) = GWPC x 0.001
based on results from a leaching test

GB Areas:
Organic Chemicals: PMC (mg/kg) = GWPC x 0.2
Inorganic Chemicals: PMC (mg/L) = GWPC x 0.01
based on the results from a leaching test

Groundwater Protection Criteria

Recommended Groundwater Protection Criteria (GWPC) were designed to establish health-protective concentrations for substances in groundwater assuming that people use the groundwater as a drinking water resource. The recommended Groundwater Protection Benchmarks were derived using the equations for calculating the Groundwater Protection Criteria contained in the 1996 Remediation Standard Regulations, which were modeled upon the risk-based assumptions used to derive federal drinking water standards. These standards focus on the exposure of adults to potential contaminants in groundwater which is used as a source of drinking water. If a federal drinking water Maximum Contaminant Level (MCL) (USEPA 2015f) or a Connecticut Action Level for Private Wells (CTDPH 2013) has been established for the substance, the MCL or Action Level was used in place of a newly calculated risk-based value.

In addition to evaluating risks from drinking groundwater, the potential for unacceptable tastes or odors to occur as a result of the presence of a substance in groundwater was also considered. These taste and odor thresholds are based on the secondary federal Maximum Contaminant Levels or published values from the literature (USEPA 2015f, Amoor & Hautala 1983, Ruth 1986, USEPA 1992, IAQUK 2015). If the concentration in water associated with unacceptable tastes or odors is less than the calculated risk-based value, the recommended Groundwater Protection Numeric Value was set equal to the taste or odor threshold.

The derivation of the recommended GWPC is presented in Table 5.

Equations used to calculate risk-based Groundwater Protection Criteria:

For substances that are non-carcinogenic:

$$GWPC\ (ug/L) = (RfD \times HI) \times \frac{(BW \times AT \times SA)}{(IR \times EF \times ED \times CF)}$$

For substances that are carcinogenic:

$$GWPC\ (ug/L) = \frac{Risk}{CSF} \times \frac{(BW \times AT)}{(IR \times ED \times EF \times CF)}$$

Where:

Variable	Description	Value	Units
AT	Averaging Time	25550	days
BW	Body Weight	70	kg
CSF	Cancer Slope Factor	chemical specific	1/mg/kg/d
CF	Conversion Factor	0.001	mg/ug
ED	Exposure Duration	70	years
EF	Exposure Frequency	365	days/year
GWPC	Groundwater Protection Criteria	chemical specific	ug/L
HI	Hazard Index	1	unitless
IR	Ingestion Rate	2	liter/day
RfD	Reference Dose	chemical specific	mg/kg/d
RL	Risk Level	1.00E-06	unitless
SA	Source Allocation	2.00E-01	unitless

Simplified Formulas:

Substance Type	GWPC ug/L
Non-carcinogen	7000 x RfD
Carcinogen	0.035 / CSF

Surface Water Protection Criteria

Surface Water Protection Criteria (SWPC) were developed to address contaminated ground water which could potentially discharge to a surface water body. The criteria are applicable to groundwater and are designed to prevent unacceptable impacts to surface waters and the people and aquatic communities that use this resource. Surface Water Protection Criteria are established using water quality criteria for surface water bodies, including Ambient Water Quality Criteria for the Protection of Human Health, which assume that fish may be caught and consumed from the surface water body, and also Ambient Water Quality Criteria for the Protection of Aquatic Life from chronic toxic impacts.

Water Quality Criteria for Human Health Protection

Water quality criteria for human health were taken directly from the Connecticut water quality criteria for fish consumption contained in the current Connecticut Water Quality Standards (CTWQS) (CTDEEP 2013a). If a criteria was not available within the CTWQS, water quality criteria recommended by EPA were used (USEPA 2015d). If a criterion was not available in either case, a water quality criterion protective of human health based on fish consumption was calculated.

The equations from the EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) (USEPA 2000) were used to characterize risks to people based on non-cancer effects and cancer effects, using a linear low-dose extrapolation. However, for consistency with the current Connecticut human health based water quality criteria, the relative source contribution factor was not used and a bioconcentration factor was used in place of the bioaccumulation factor. The current Connecticut water quality criteria were adopted in February 2011 directly from EPA criteria recommendations at that time which included these adjustments.

Bioconcentration Factors used in the calculation of water quality criteria protective of human health were obtained from individual documents for water quality criteria for individual chemicals published by the EPA or were derived using structure activity relationships based on the octanol/water partition coefficient for each chemical. Octanol/water partition coefficients were obtained from the ChemIDplus database (NIH 2007 and 2015). Bioconcentration Factors were calculated using the BCFwin module (Meylan *et al* 1999) of the USEPA Estimation Programs Interface Suite software (USEPA 2007).

Equations used to calculate risk-based Water Quality Criteria for Human Health based on Fish Consumption

For Substances that are Non-carcinogenic:

WQC = (RfD x BW x CF) / (FC x BCF)

For Substances that are Carcinogenic:

WQC = (RL x BW x CF) / (CSF x FC x BCF)

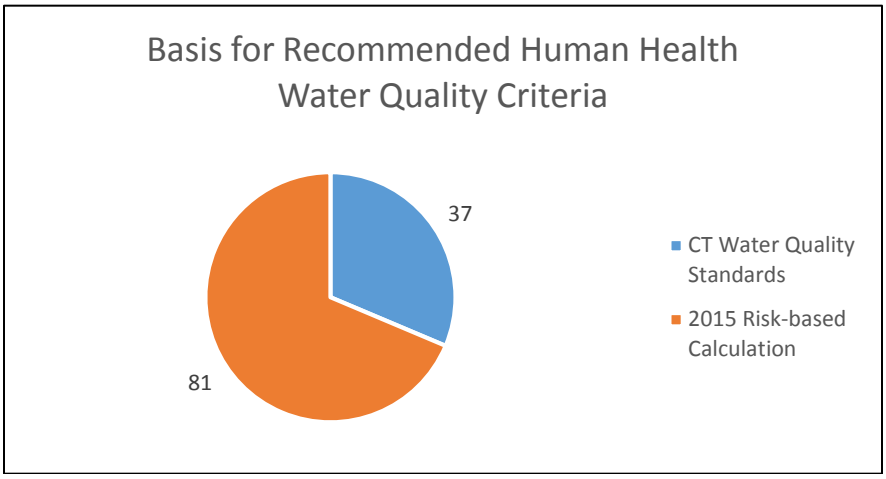
Where:

Variable	Description	Value	Units
BCF	Bioconcentration Factor	chemical specific	unitless
BW	Body Weight	70	kg
CF	Conversion Factor	1000	ug/mg
CSF	Cancer Slope Factor	chemical specific	kg-d/mg
FC	Fish Consumption Rate	0.0175	kg/d
RfD	Reference Dose	chemical specific	mg/kg-d
RL	Risk Level	1.00E-06	unitless
WQC	Water Quality Criteria	chemical specific	ug/L

Simplified Formulas:

Substance Type	Human Health Water Quality Criteria based on Fish Consumption
Non-carcinogen:	4,000,000 x (RfD / BCF)
Carcinogen:	4 / (CSF x BCF)

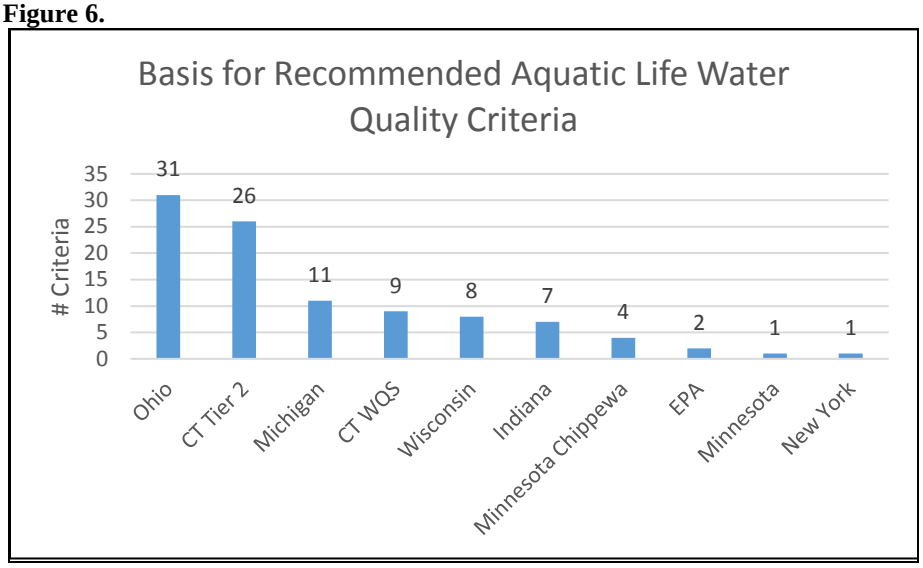
Figure 5.



Water Quality Criteria for Aquatic Life Protection

Water quality criteria for aquatic life were taken directly from the Connecticut water quality criteria for freshwater chronic aquatic life protection contained in the current Connecticut Water Quality Standards (CTWQS) (CTDEEP 2013a). If a criterion was not available within the CTWQS, national recommendations from EPA for water quality criteria were selected. If a criterion was not available from either source, aquatic life based water quality criteria were either selected from criteria published by the Great Lakes States within the Great Lakes Water Quality Clearinghouse or were derived by CTDEEP using the current published EPA methodologies (USEPA 1985, USEPA 1995). Selection of the aquatic life water quality criteria was based on the strength of the toxicity information and consistency with nationally recommended protocols for deriving such criteria. Twenty-six percent (26%) of the recommended aquatic life water quality criteria were based on CTDEEP calculations while 74% were based on published values from EPA or other States and Tribes.

Figure 6.



Calculation of Surface Water Protection Criteria

Surface Water Protection Criteria (SWPC) are designed to be applied under low flow conditions, consistent with the requirements for ambient water quality criteria. The Water Quality Standards (CTDEEP 2013a) specify that Water Quality Criteria are to be applied under 7Q10 flow conditions, which represents a low flow which occurs approximately 1% of the time. This flow was selected by EPA as it is consistent with the short term exposure assumptions on which the aquatic life criteria are based. Human health based Water Quality Criteria have different exposure periods related to the mode of action of the chemical, either noncancer or cancer based endpoints. This would translate to application under differing flows within the surface water, flows which were greater than the 7Q10 flow. For noncarcinogens, EPA recommended applying the criteria under 30Q2 flows, which Connecticut determined to be approximately 2x the 7Q10 flow. For carcinogens, EPA recommended applying the criteria under Mean Harmonic Flows, which Connecticut determined to be approximately 3x the 7Q10 flows. CT DEEP used these "flow factors" to address this issue. The human health based Water Quality Criteria for noncarcinogens were multiplied by 2 and Water Quality Criteria for carcinogens were multiplied by 3 to allow for application under 7Q10 flows. Exceptions to this were made for chemicals that were designated by EPA as known human carcinogens or for chemicals with a higher potential to bioaccumulate. For these chemicals, a flow factor of 1 was used.

In addition to considering the river flows under which SWPC were to be applied, the default SWPC are based on an assumption of 10:1 dilution being available within the surface water body.

Based on these considerations, the risk-based SWPC are calculated as the lower of:

Water Quality Criterion for Chronic Freshwater Aquatic Life Protection x 10

OR

Human Health based Water Quality Criterion for Fish Consumption x Flow Factor x 10

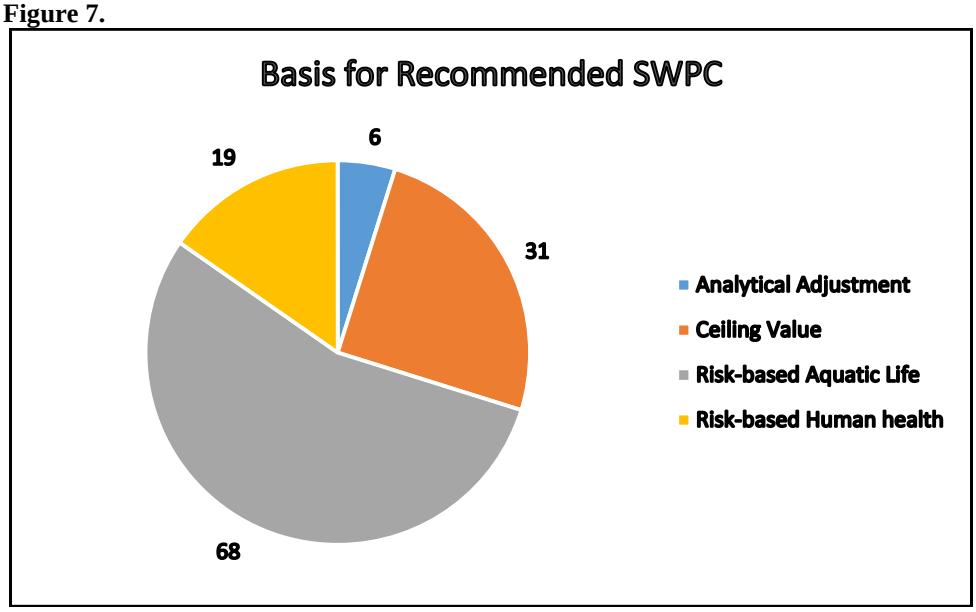
Where:

Flow Factor = 1 for known human carcinogens or substances which may bioaccumulate
Flow Factor = 2 for non-carcinogenic substances
Flow Factor = 3 for carcinogenic substances

Substances were considered known human carcinogens if they were identified as Class A in the USEPA (IRIS (Class A)) or identified as Class 1 in the World Health Organization, International Agency for Cancer Registry (IARC (Class 1)). Substances were identified as highly bioaccumulative if the BCF factor was greater than 1000.

Table 6 presents the derivation of the recommended SWPC including information on the recommended human health and aquatic life water quality criteria.

Figure 7.


Basis for Recommended SWPC
6
31
68
19
Analytical Adjustment
Ceiling Value
Risk-based Aquatic Life
Risk-based Human health

Target Indoor Air Concentrations and Volatilization Criteria

Target Indoor Air Concentrations (TAC) are designed to support the development of risk-based volatilization criteria. The recommended risk-based TAC were calculated using the equations and assumptions used to derive the Proposed Revisions: Connecticut's Remediation Standard Regulations Volatilization Criteria (CTDEEP 2003) and form the basis for deriving the recommended volatilization criteria.

Risk-based TAC were compared with measured indoor air concentrations or odor thresholds, where data was available, to determine if the risk-based TAC needed to be adjusted. If the risk-based TAC were less than the observed reference indoor air concentrations, the TAC were adjusted up to the reference condition. The reference conditions for indoor air concentrations were obtained from a report on typical concentrations of various contaminants found in indoor air published by MADEP in December 2008 in a publication entitled Residential Typical Indoor Air Concentrations (MADEP 2008). This document summarized the results of various studies and presents a table of observed contaminant concentrations in indoor air and provides the 50^{th}, 75^{th} and 90^{th} percentile values. The 75^{th} percentile values were used as reference conditions for residential indoor air. Since similar studies were not available for indoor air in an industrial/commercial setting, the 90^{th} percentile value from the residential study was used to represent potential reference conditions in an industrial/commercial setting.

If the risk-based TAC was greater than the odor threshold for a substance in air, the TAC was adjusted down to the published odor threshold in air (USEPA 2015f, Amoor & Hautala 1983, Ruth 1986, USEPA 1992, IAQUK 2015).

Derivation of the recommended TAC is presented in Tables 7 and 8.

Residential Risk-based Target Indoor Air Concentration Formulas

For Substances that are Non-carcinogenic:

TAC = (HQ x BW x RfDi x AT x CF) / (CexpF x IRair x EF x ED)

For Substances that are Carcinogenic:

TAC = (RL x BW x RfDi x ATc x CF) / (CSFi x CexpF x CsensF x IRair x EF x ED)

Where:

Variable	Description	Value	Units
AT	Averaging Time – Non-carcinogen	10950	days
ATc	Averaging Time – Carcinogen	25550	days
BW	Body Weight	70	kg
CexpF	Children's Exposure Factor	2	unitless
CF	Conversion Factor	1000	ug/mg
CsensF	Children's Sensitivity Factor	#	unitless
CSFi	Cancer Slope Factor – Inhalation	chemical specific	kg-d/mg
ED	Exposure Duration	30	years
EF	Exposure Frequency	350	days/year
HQ	Hazard Quotient	1	unitless
IRair	Inhalation Rate – Air	20	m^3/day
RfDi	Reference Dose – Inhalation	chemical specific	mg/m^3
RL	Risk Level	1.00E-06	unitless
TAC	Target Indoor Air Concentration	chemical specific	ug/m^3

#: CsensF = 1 for noncarcinogens and nonmutagenic carcinogens.
CsensF = 2 for mutagenic carcinogens

Simplified Formulas:

Substance Type	Residential Target Indoor Air Concentration
Non-carcinogen:	1825 x Rfdi x CsensF
Carcinogen:	0.00426 / (CSFi x CsensF)

Industrial/Commercial Risk-based Target Indoor Air Concentration Formulas

For Substances that are Non-carcinogenic:

TAC = (HQ x BW x RfDi x AT x CF) / ((IRair x EF x ED)

For Substances that are Carcinogenic:

TAC = (RL x BW x ATc x CF) / ((CSFi x IRair x EF x ED)

Where:

Variable	Description	Value	Units
AT	Averaging Time – Non-carcinogen	9125	days
ATc	Averaging Time – Carcinogen	25550	days
BW	Body Weight	70	kg
CF	Conversion Factor	1000	ug/mg
CSFi	Cancer Slope Factor – Inhalation	chemical specific	kg-d/mg
ED	Exposure Duration	25	years
EF	Exposure Frequency	250	days/year
HQ	Hazard Quotient	1	unitless
IRair	Inhalation Rate – Air	10	m^3/day
RfDi	Reference Dose – Inhalation	chemical specific	mg/m^3
RL	Risk Level	1.00E-06	unitless
TAC	Target Indoor Air Concentration	chemical specific	ug/m^3

Simplified Formulas:

Substance Type	Industrial/Commercial Target Indoor Air Concentration
Non-carcinogen:	10220 x Rfdi
Carcinogen:	0.02862 / CSFi

Volatilization Criteria

Volatilization Criteria are designed to model concentrations of volatile substances in ground water and soil vapor such that if these substances were to enter the indoor air within a building, the recommended TAC would be met. The recommended risk-based remediation volatilization criteria for groundwater and soil vapor were calculated using the equations and assumptions used to derive the Proposed Revisions: Connecticut's Remediation Standard Regulations Volatilization Criteria (CTDEEP 2003). The derivation of the recommended volatilization criteria is presented in Table 9.

Risk-based Volatilization Criteria Formulas

For Ground Water Volatilization Criteria:

$$GWVC\ (ug/L) = TAC / (1000\ L/m^3 \times \alpha \times H)$$

For Soil Vapor Volatilization Criteria:

$$SVVC\ (mg/m^3) = TAC / (1000\ ug/mg \times \alpha)$$

$$SVVC\ (ppm) = SVVC\ (mg/m^3) \times 24.45 / Molecular\ Weight$$

Where:

$$\alpha = (A \times e^B) / (e^B + A + (A/C) \times (e^B - 1))$$

Where:

$A = (D^{eff}_T \times A_B) / (Q_B \times L_T)$ ***or*** $(D^{eff}_T) / (E_B \times (V_B/A_B) \times L_T)$

$B = (Q_{soil} \times L_{crack}) / (D^{eff}_{crack} \times \eta \times A_B)$ ***or*** $((Q_{soil}/Q_b) \times E_B \times (V_B/A_B) \times L_{crack}) / (D^{eff}_{crack} \times \eta)$

$C = (Q_{soil}/Q_b)$

Where:

$$D^{eff}_T = L_T / ((L_{vadose}/D^{eff}_{vadose}) + (L_{cap}/D^{eff}_{cap})$$

$$D^{eff}_{crack} = D^{air} \times (\theta_{V\text{-}crack}^{3.33}/\theta_{T\text{-}crack}^{2}) + (D^{water}/H) \times (\theta_{m\text{-}crack}^{3.33}/\theta_{T\text{-}crack}^{2})$$

Where:

$$D^{eff}_{vadose} = D^{air} \times (\theta_{V\text{-}vadose}^{3.33} / \theta_{T\text{-}vadose}^{2}) + (D^{water}/H) \times (\theta_{m\text{-}vadose}^{3.33} / \theta_{T\text{-}vadose}^{2})$$

$$D^{eff}_{cap} = D^{air} \times (\theta_{V\text{-}cap}^{3.33} / \theta_{T\text{-}cap}^{2}) + (D^{water}/H) \times (\theta_{m\text{-}cap}^{3.33} / \theta_{T\text{-}cap}^{2})$$

Where:

Variable	Description	Value	Units
GWVC	Ground Water Volatilization Criteria	calculated	ug/kg
TAC	Target Indoor Air Concentration	Appendix D	ug/m^3
α	Attenuation Factor for Diffusion and Advection	calculated	unitless
SVVC	Soil Vapor Volatization Criteria	calculated	mg/m^3
24.45	Molar Volume (at standard conditions)	24.45	liters
D^{eff}_T	Total Effective Diffusion	calculated	cm^2/s
D^{eff}_{crack}	Effective Diffusion Through Foundation Cracks	calculated	cm^2/s
D^{eff}_{cap}	Effective Diffusion Through Capillary Fringe	calculated	cm^2/s
D^{eff}_{vadose}	Effective Diffusion Through Vadose Zone	calculated	cm^2/s
H	Henry's Law Constant	chemical specific	unitless
$\theta_{m\text{-}vadose}$	Volumetric Moisture Content in Vadose Zone	calculated	unitless
$\theta_{T\text{-}vadose}$	Total Porosity in Vadose Zone	calculated	unitless
$\theta_{m\text{-}crack}$	Volumetric Moisture Content in Cracks	calculated	unitless
$\theta_{T\text{-}crack}$	Total Porosity in Crack	calculated	unitless
$\theta_{m\text{-}cap}$	Volumetric Moisture Content in Cracks in Capillary Fringe	calculated	unitless
$\theta_{T\text{-}cap}$	Total Porosity in Capillary Fringe	calculated	unitless
D^{air}	Molecular Diffusion Coefficient in Air	chemical specific	m^2/d
D^{water}	Molecular Diffusion Coefficient in Wat	chemical specific	m^2/d
η	Fraction of Enclosed Space Area Open for Vapor Intrusion	calculated	m^2/d
A_B	Surface Area of the Enclosed Space in Contact with Soil	calculated	m^2
V_B	Enclosed Space Volume	calculated	m^3
E_B	Enclosed Space Air Exchange Rate	calculated	1/day
L_T	Depth from foundation to source	calculated	m
L_{cap}	Thickness of Capillary Fringe	calculated	m
L_{crack}	Foundation Thickness	calculated	m
Q_B	Enclosed Space Volumetric Air Flow Rate	calculated	m^3/d
$\theta_{v\text{-}vadose}$	Volumetric Vapor Content in Vadose Zone	calculated	unitless
$\theta_{V\text{-}crack}$	Volumetric Vapor Content in Cracks	calculated	unitless
$\theta_{V\text{-}cap}$	Volumetric Vapor Constant in Capillary Fringe	calculated	unitless

Definition of Variables

Variable	Definition	Units
H	Chemical Specific Henry's Law constant	$\mu g/m^3$-vapor / $\mu g/m^3$-H_2O
$\theta_{m\text{-}vadose}$	Volumetric Moisture Content in Vadose Zone	m^3-H_2O / m^3-soil
$\theta_{T\text{-}vadose}$	Total Porosity in Vadose Zone	m^3-voids / m^3-soil
$\theta_{m\text{-}crack}$	Volumetric Moisture Content in Cracks	m^3-H_2O / m^3-soil
$\theta_{T\text{-}crack}$	Total Porosity in Cracks	m^3-voids / m^3-soil
$\theta_{m\text{-}cap}$	Volumetric Moisture Content in Cracks in Capillary Fringe	m^3-H_2O / m^3-soil
$\theta_{T\text{-}cap}$	Total Porosity in Capillary Fringe	m^3-voids / m^3-soil
D^{air}	Chemical Specific Molecular Diffusion Coefficient in Air	m^2 / d
D^{water}	Chemical Specific Molecular Diffusion Coefficient in Water	m^2 / d
K	Soil Permeability (near foundation) to Air Flow	m^2
ΔP	Indoor-Outdoor Air Pressure Difference	g / ms^2
X_{crack}	Total Length of Cracks through which Soil Gas Vapors are Flowing	m
μ	Viscosity of Air	g / ms
Z_{crack}	Crack Opening Depth Below Grade	m
η	Fraction of Enclosed Space Area Open for Vapor Intrusion	m^2 / m^2
A_B	Surface Area of the Enclosed Space in Contact with Soil	m^2
V_B	Enclosed Space Volume	m^3
E_B	Enclosed Space Air Exchange Rate	1/d
L_T	Depth from Foundation to Source	m
L_{cap}	Thickness of Capillary Fringe	m
L_{crack}	Foundation Thickness	m

Calculated Variables

Variable	Definition	Calculation	Units
V_B/A_B	Ratio of Enclosed Space Volume to Exposed Surface Area		m
Q_B	Enclosed Space Volumetric Air Flow Rate	$= V_B E_B$	m^3 / d
R_{crack}	Effective Crack Radius or Width	$= \eta A_B / X_{crack}$	m
$\theta_{V\text{-}vadose}$	Volumetric Vapor Content in Vadose Zone	$= \theta_{T\text{-}vadose} - \theta_{m\text{-}vadose}$	m^3-vapor / m^3-soil
$\theta_{V\text{-}crack}$	Volumetric Vapor Content in Cracks	$= \theta_{T\text{-}crack} - \theta_{m\text{-}crack}$	m^3-vapor / m^3-soil
$\theta_{V\text{-}cap}$	Volumetric Vapor Content in Capillary Fringe	$= \theta_{T\text{-}cap} - \theta_{m\text{-}cap}$	m^3-vapor / m^3-soil
Q_{soil}	Pressure Driven Soil Gas Flow Rate from the subsurface into the enclosed space	$= (2\pi k \Delta P X_{crack}) / [\mu \ln(2Z_{crack}/R_{crack})]$	m^3 / d
Q_{soil}/Q_B	Ratio of Soil Gas Intrusion Rate to Building Ventilation Rate		unitless
D^{water}/D^{air}	Ratio of Molecular Diffusion in water to air		unitless
L_{vadose}	Thickness of Vadose Zone	$= L_T - L_{cap}$	m

Default Input Values

Variable	Units	Typical Value Range [1]	Notes	Res GWVC	I/C GWVC	Res SVVC	I/C SVVC
H	$\mu g/m^3$-vapor / $\mu g/m^3$-H_2O	0.01 - 1.0	For most aromatic & chlorinated solvents	---	---	---	---
$\theta_{m\text{-}vadose}$	m^3-H_2O / m^3-soil		ASTM default value. Typical for sand.	0.12	0.12	0.12	0.12
$\theta_{T\text{-}vadose}$	m^3-voids / m^3-soil		ASTM default value. Typical for sand.	0.38	0.38	0.38	0.38
$\theta_{m\text{-}crack}$	m^3-H_2O / m^3-soil		ASTM default value. Typical for sand.	0.12	0.12	0.12	0.12
$\theta_{T\text{-}crack}$	m^3-voids / m^3-soil		ASTM default value. Typical for sand.	0.38	0.38	0.38	0.38
$\theta_{m\text{-}cap}$	m^3-H_2O / m^3-soil		ASTM default value. Typical for sand.	0.342	0.342	0.342	0.342
$\theta_{T\text{-}cap}$	m^3-voids / m^3-soil		ASTM default value. Typical for sand.	0.38	0.38	0.38	0.38
D^{air}	M^2 / d	0.1 - 1	For most chemicals	7.26E-01	7.26E-01	7.26E-01	7.26E-01
D^{water}	M^2 / d			8.64E-05	8.64E-05	8.64E-05	8.64E-05
k	m^2	1E-6 - 1E-12					
ΔP	g / ms^2	0 - 200	or 0 to 20 Pascals				
X_{crack}	m						
μ	g / ms						
Z_{crack}	m						
η	m^2 / m^2	0.0005 - 0.005	ASTM default value. 0.01 for worst-case scenario.	0.01	0.01	0.01	0.01
A_B	m^2						
V_B	m^3	147 - 672	Range from USDOE (1995)				
E_B	1/d	4.8 - 24	ASTM default values. 12 for Residential scenario and 19.9 for Industrial/Commercial scenario.	12	19.9	12	19.9

Default Input Values (continued)

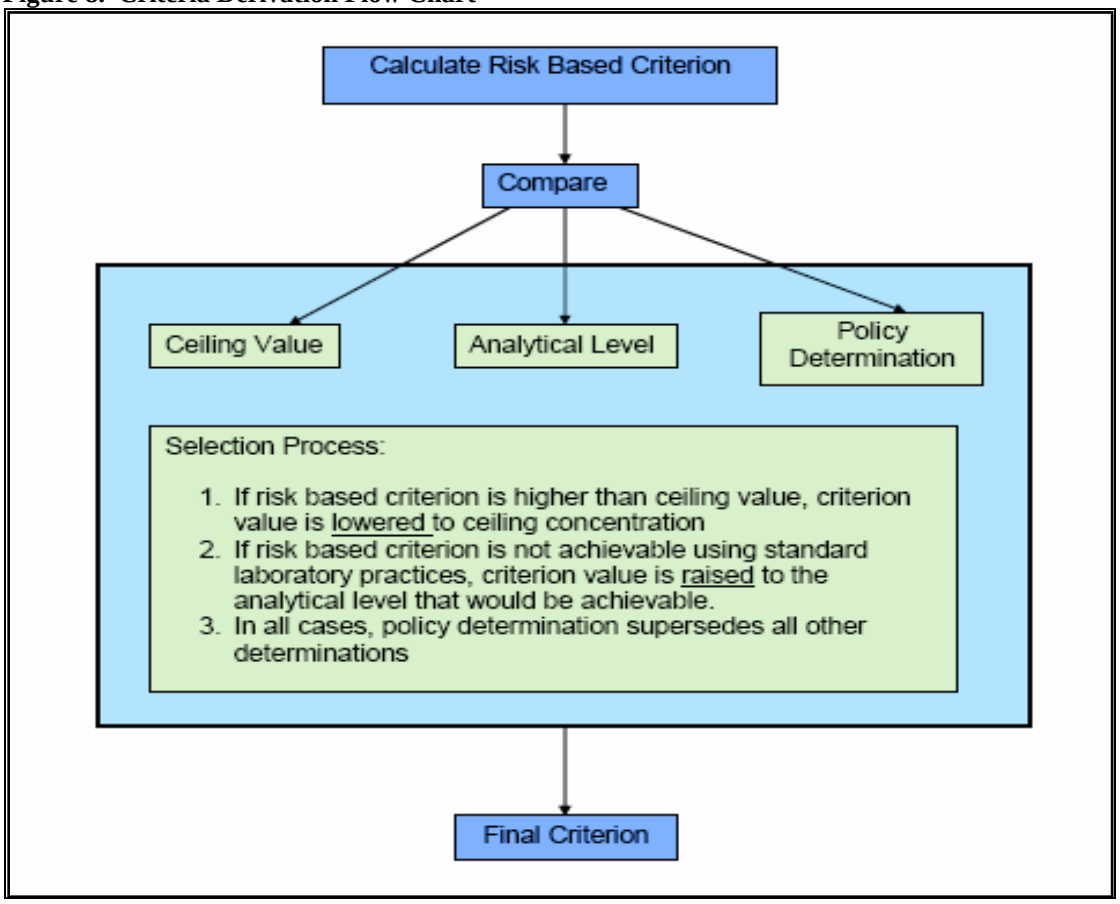
Variable	Units	Typical Value Range [1]	Notes	Res GWVC	I/C GWVC	Res SVVC	I/C SVVC
L_T	m	0.01 - 50	ASTM default values. 3 for Groundwater criteria and 1 for Soil Vapor criteria.	3	3	1	1
L_{cap}	m		ASTM default values. 0.05 for Groundwater criteria and 0 for Soil Vapor criteria.	0.05	0.05	0	0
L_{crack}	m	0.15 - 0.5	ASTM default value.	0.15	0.15	0.15	0.15
V_B/A_B	m	2 - 3	ASTM default values. 2 for Residential scenario and 3 for Industrial/Commercial scenario.	2	3	2	3
Q_B	m^3 / d						
R_{crack}	m						
$\theta_{V\text{-}vadose}$	m^3-vapor / m^3-soil		ASTM default value. Typical for sand.	0.26	0.26	0.26	0.26
$\theta_{V\text{-}crack}$	m^3-vapor / m^3-soil		ASTM default value. Typical for sand.	0.26	0.26	0.26	0.26
$\theta_{V\text{-}cap}$	m^3-vapor / m^3-soil		ASTM default value. Typical for sand.	0.038	0.038	0.038	0.038
Q_{soil}	m^3 / d						
Q_{soil}/Q_B	unitless	0.0001 – 0.05	EPA Vapor Intrusion Guidance default value.	0.003	0.003	0.003	0.003
D^{water}/D^{air}	unitless	~ 1E-4		1.19E-04	1.19E-04	1.19E-04	1.19E-04
L_{vadose}	m		ASTM default value. 2.95 for Groundwater criteria and 1 for Soil Vapor criteria.	2.95	2.95	1	1

[1] Johnson, (2002), *Identification of Critical Parameters for the Johnson and Ettinger (1991) Vapor Intrusion Model*, API Bulletin #17, May.

Risk Management: Adjustments to Risk-based Environmental Criteria

Once the risk-based values were calculated through the risk assessment process, using the toxicity values and formulas for each criteria type, the resulting risk-based criteria were adjusted, as necessary, to account for ceiling values, analytical levels or policy considerations.

Figure 8. Criteria Derivation Flow Chart



Ceiling Values

Ceiling values are used as an upper bound value to prevent gross contamination from being overlooked or left in place. The use of these values provides protection of the chemical, physical and biological integrity of the state's environmental resources and recognizes that risk-based evaluations represent the information available at the time the criteria were derived. Should additional new toxicity information become available in the future which indicates that a substance is more toxic than originally thought, the ceiling value provides some measure of protection. Additionally, ceiling values are useful to address other exposure conditions not explicitly included in criteria calculation, consideration of multiple pathways of exposure to the same or similar compounds or to complex mixtures.

In order to prevent excessive contamination from being left in place, upper limits on the acceptable concentration for remediation criteria have been retained for use in establishing remediation criteria. In the 1996 RSRs, ceiling concentrations were established for Direct Exposure Criteria and Groundwater Volatilization Criteria. In 2003, proposed revisions the Volatilization Criteria also included a ceiling concentration for Target Indoor Air Concentrations.

Ceiling Values Used in Criteria Derivation

Criteria Type	Units	Volatile Substances	Semivolatile Substances	Pesticides	Inorganic
Direct Exposure Criteria: Residential	mg/kg	500	1000	500	50,000
Direct Exposure Criteria: Industrial Commercial	mg/kg	1000	2500	1000	50,000
Groundwater Protection Criteria	ug/l	1000	1000	1000	1000
Target Indoor Air Concentration	ug/m^3	500	NA	NA	NA
Groundwater Volatilization Criteria	ug/l	50,000	NA	NA	NA
Surface Water Protection Criteria	ug/l	10,000	10,000	10,000	10,000

NA: Not Applicable

Adjustments to Criteria based on Analytical Considerations

Adjustments to risk-based values were made if it was not possible to reliably quantify the amount of chemicals present using sensitive laboratory methods. In these cases, the criteria value was adjusted upwards to the analytical reporting associated with sensitive methods that were routinely used at remediation sites. The Superfund Contract Required Quantification Limits identified by the EPA Superfund Contract Lab Program were generally used to guide selection of common analytical levels (USEPA 2015g) for soil and groundwater. Analytical levels are chemical-specific for soil and groundwater and are provided in the tables showing the derivation of the recommended criteria. For Volatilization Criteria, a value of 0.5 ppb was used as the analytical level to adjust Soil Vapor Volatilization Criteria, as recommended in the CTDEEP 2003 Volatilization Criteria document.

Policy Considerations

The proposed criteria have been reviewed to determine if any additional modifications should be included in order to address any additional concerns.

1. Consideration of General Ambient Concentrations

   For risk-based values that are below general background environmental concentrations, the criteria were adjusted up from the risk-based value to one consistent with estimated reference conditions. Within this document, this adjustment was applied to the Target Indoor Air Concentrations when published applicable data was available.

2. Significant Digits / Rounding

   The calculated criteria values adjusted to present values based on an appropriate number of significant digits. Standard rounding conventions were applied as necessary.

3. Consistency with Other Regulatory Programs

   EPA and CTDPH have recommended or promulgated Maximum Contaminant Levels (MCLs) and Action Levels for certain substances in drinking water supplies. Risk based GWPC criteria were compared to the established Maximum Contaminant Levels or Action Levels and adjusted, as needed, for consistency with these values.

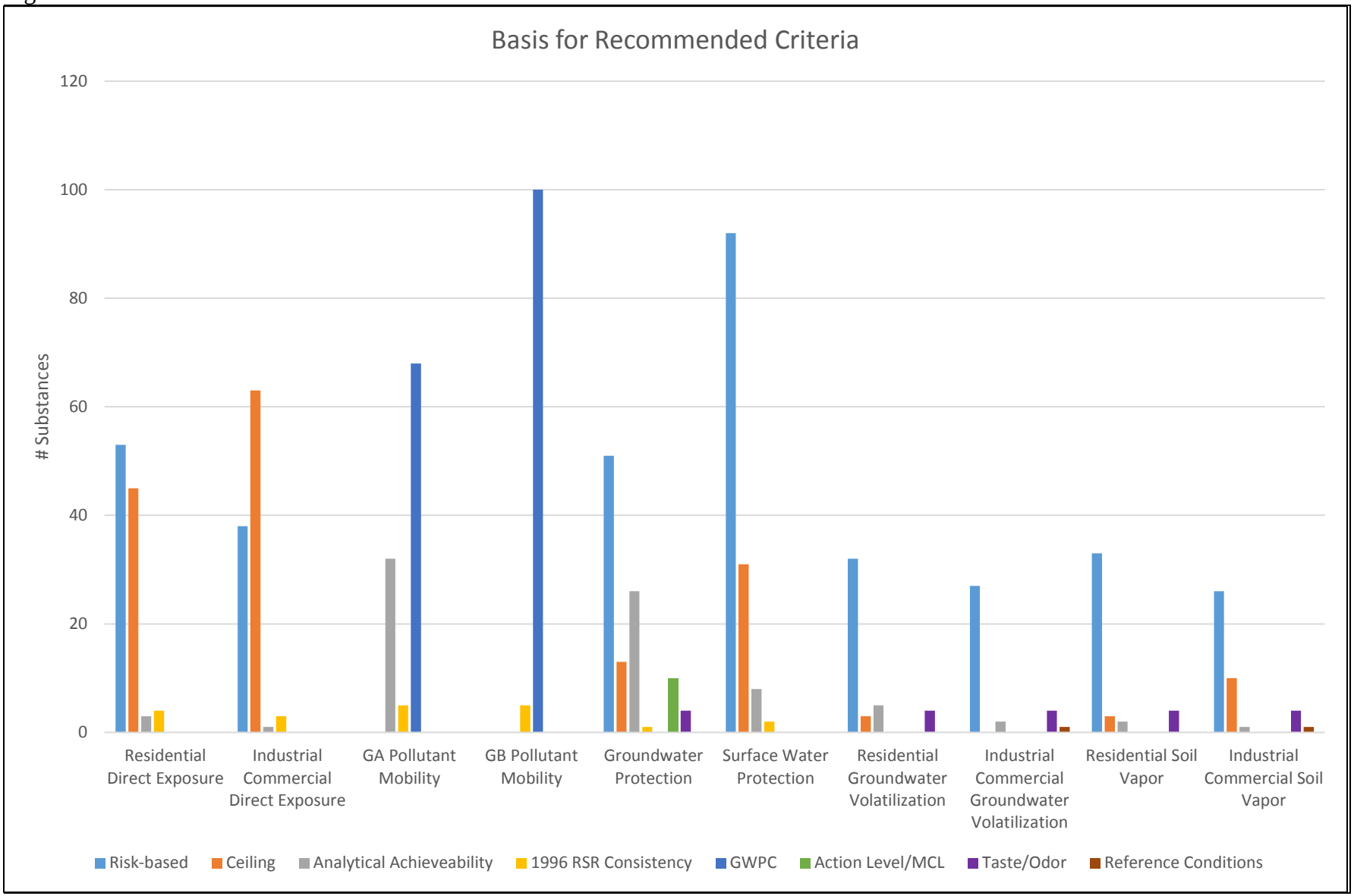
4. Other Exposure Considerations

   In addition to direct impacts from ingesting or inhaling substances contained in groundwater or expect to be in indoor air, there is also a concern for odor from these substances to impact people, through bathing and showering exposures or generally through indoor air concentrations. Risk based values for Groundwater Protection Criteria and Target Indoor Air Concentrations were adjusted based on odor thresholds if the risk based criteria were above such thresholds.

Summary Table of CTDEEP Recommended Criteria for Common Additional Polluting Substances and Alternative Criteria Requests

A summary of the recommended criteria for the various chemicals and criteria types is presented in Table 10.

Figure 9: Basis for Recommended Criteria



Bibliography

Amoore JE and Hautala E 1983. Odor as an aid to chemical safety: odor thresholds compared with TLVs and volatilities for 214 industrial chemicals in air and water dilution. J Appl Toxicol 3: 272-289.

ATSDR 2015. Agency for Toxic Substances and Disease Registry Minimum Risk Levels http://www.atsdr.cdc.gov/mrls/index.asp

CAL-OEHHA 2015. CAL-OEHHA: California Office of Environmental Health Hazard Assessment http://oehha.ca.gov/tcdb/index.asp

CTDEEP 2003. Connecticut's Proposed Revisions Remediation Standard Regulations Volatilization Criteria. Available at: http://www.ct.gov/dep/lib/dep/site_clean_up/remediation_regulations/RvVolCri.pdf

CTDEEP 2012. Petroleum Hydrocarbons Using the EPH/EPH/APH Analytica Methods and Criteria Development Technical Support Document. http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

CTDEEP 2013. Remediation Standard Regulations. Available at http://www.ct.gov/deep/lib/deep/regulations/22a/22a-133k-1through3.pdf

CT DEEP 2013a. Water Quality Standards Available at: http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf

CTDEEP 2015. CT DEEP Risk Based Decision Making Recommendations Report (April 15, 2015) Available at: http://www.ct.gov/deep/lib/deep/site_clean_up/comprehensive_evaluation/risk-based_decision-making_recommendation_report.pdf

CTDPH 2013. Action Level List for Private Wells (http://www.ct.gov/dph/lib/dph/environmental_health/eoha/pdf/pw_action_levels.pdf)

IAQUK2015. Indoor Air Quality UK Resources – Odour Detection and Thresholds http://www.iaquk.org.uk/ResourcesOdours.html

IARC2015. International Agency for Research on Cancer, World Health Organization List of Classifications http://monographs.iarc.fr/ENG/Classification/

Meylan,WM, Howard,PH, Boethling,RS et al. 1999. "Improved Method for Estimating Bioconcentration / Bioaccumulation Factor from Octanol/Water Partition Coefficient", Environ. Toxicol. Chem. 18(4): 664-672 (1999)

NIH 2007 & 2015. National Institute of Health ChemID plus database http://chem.sis.nlm.nih.gov/chemidplus/

PAN 2015. Pesticide Action Network Pesticide Database http://www.pesticideinfo.org/

Ruth JH 1986. Odor thresholds and irritation levels of several chemical substances: a review. Am Ind Hyg Assoc J 47: A142-A151.

USEPA 1985. 1985 EPA Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (PB85-227049) (http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/85guidelines.pdf) and

USEPA 1989. Risk Assessment Guidance for Superfund http://www2.epa.gov/risk/risk-assessment-guidance-superfund-rags-part

USEPA1992. Reference Guide to Odor Thresholds for Hazardous Air Pollutants Listed in the Clean Air Act Amendments of 1990. EPA/600/R-92/047. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=40610

USEPA 1995. Appendix A to 40 CFR Part 132, Great Lakes Water Quality Initiative Methodologies for
Development of Aquatic Life Criteria and Values (http://www.ecfr.gov/).

USEPA2000. EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) (EPA-822-B-00-004) http://water.epa.gov/scitech/swguidance/standards/upload/2005_05_06_criteria_humanhealth_method_complete.pdf

USEPA2007. Estimation Programs Interface Suite™ for Microsoft® Windows, v3.20 United States Environmental Protection Agency, Washington, DC, USA. Available: http://www2.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface

USEPA2011. Great Lakes Initiative Toxicity Data Clearinghouse. V 2.11 March 2011 Available at http://www2.epa.gov/gliclearinghouse

USEPA2015a. Integrated Risk Information System. Available at: http://www2.epa.gov/iris

USEPA2015b. USEPA PPRTV: EPA Provisional Peer Reviewed Toxicity Values for Superfund Available at: http://hhpprtv.ornl.gov/

USEPA2015c. EPA Health Effects Assessment Summary Tables for Superfund http://epa-heast.ornl.gov/

USEPA2015d. EPA National Recommended Water Quality Criteria Available at: http://www2.epa.gov/wqc/national-recommended-water-quality-criteria

USEPA2015e. ECOTOX Database. Available at: http://cfpub.epa.gov/ecotox/

USEPA 2015f. National Drinking Water Contaminants http://water.epa.gov/drink/contaminants/

USEPA 2015g. CLP EPA Superfund Contract Lab Program were generally used to guide selection of common analytical levels. (http://www.epa.gov/superfund/programs/clp/target.htm)

Appendix A: Toxicological Monographs

Acetonitrile:

Non-cancer –

IRIS RfD: Not Available
IRIS RfC: 0.06 mg/m^3
Converts to 0.017 mg/kg/d via dose route extrapolation
ATSDR MRL: Not available
CalEPA Chronic REL: Not available
CTDPH Assessment: RfD; 0.005 mg/kg/day

The RfC is based upon the No Observed Adverse Effects Level (NOAEL) for severe toxicity (mortality) in 1996 NTP inhalation studies in mice and a cumulative 100 fold uncertainty factor (UF). However, this study showed substantial gastro-intestinal tract toxicity (fore-stomach inflammation and hyperplasia) that was attributed to preening of fur. This suggests that acetonitrile can have more substantial oral toxicity than inhalation toxicity. However, the old RfD that had been on IRIS was withdrawn due to questions regarding interpretation of the unpublished 1983 inhalation study and attendant dose route extrapolation.

Cancer –

IRIS: classified as "D" – equivocal evidence in animals and no evidence in humans; NTP 1996 studies: dose-related increases in hepatocellular and alveolar tumors. However, no slope factor is available. Not a mutagen.
CalEPA Unit Risk: Not available;

Conclusion –

An RfD of 0.005 mg/kg/d is derived based upon dose route extrapolation from IRIS RfC with 3x additional UF for evidence of forestomach damage from inhalation exposure (preening) suggesting that oral exposure is more toxic than inhalation due to contact site effects within the gastro-intestinal tract, plus the equivocal evidence of cancer in rat liver.

Aluminum:

Non-cancer –

IRIS: No values available
USEPA PPRTV (2006) Rfd= 1 mg/kg
ATSDR chronic oral MRL (2008): 1 mg/kg/d

Cancer –

Not applicable

Conclusion –

Use the USEPA PPRTV RfD and ATSDR chronic MRL of 1 mg/kg/day (2012).

The USEPA PPRTV, the ATSDR's subchronic MRL and the ATSDR chronic MRL are the same and based upon neurodevelopmental effects from in utero exposure with a 300 fold cumulative UF from a minimal Lowest Observed Adverse Effects Level (LOAEL). This MRL g/kg/d is slightly above the range of dietary background exposure (0.1 to 0.3 mg/kg/d) (ATSDR, 2007, draft Toxicological Profile for Aluminum), which means that the risk-based target value is not limited by background dietary exposures.

Ammonia:

Non-cancer –

IRIS RfD: Not available
USEPA/PPRTV: Reviewed (2005) but no RfD derived
DPH Assessment: RfD = 0.1 mg/kg/d

Also relevant: ATSDR chronic inhalation MRL: 0.1 ppm

Cancer –

Non-carcinogen

Evidence in humans suggests a LOAEL for ammonium chloride of 33.7 mg/kg/d based upon shifting of systemic acid-base balance (World Health Organization (WHO), WHO 2003, available at: http://www.who.int/water_sanitation_health/dwq/ammonia.pdf). Use of 300 fold cumulative uncertainty factor (10 for LOAEL to NOAEL, 10 for intra-human variability, 3 for database deficiencies) yields an RfD of 0.1 mg/kg/d. This is supported by an animal study involving chronic exposure via drinking water in rats in which ammonium chloride induced altered blood pH and decreased bone mass at a dose of 478 mg/kg/d. Use of cross-species, intra-human variability, LOAEL to NOAEL and database deficiency uncertainty factors of 3000 fold (cumulative) would yield a similar RfD as the human based derivation above.

The inhalation MRL from ATSDR is equivalent to an oral dose of 0.02 mg/kg/d but this was based upon a study which did not define an adverse effect (no LOAEL) and so this derivation is potentially consistent with a somewhat higher acceptable daily dose as represented by the oral RfD above. Further, dose route extrapolation is not recommended for chemicals which have substantial portal of entry effects such as ammonia.

Conclusion –

The human LOAEL of 33.7 mg/kg/d for ammonium chloride reported in the WHO drinking water document for ammonia (2003) combined with a 300 fold cumulative UF is a reasonable basis for an RfD of 0.1 mg/kg/d. However, if the chloride salt is not involved, less toxicity may be expected. Establishment of a GWPC should be aware that the odor threshold for ammonia in water is 1.5 ppm.

Benzo(g,h,i)perylene:

The following slope factor is for Benzo(g,h,i)perylene, which is a PAH with at least some evidence of carcinogenic activity in skin painting studies, initiation/promotion studies, or other protocols that evaluate tumor formation from subchronic or chronic exposure. By analogy with the prototypic PAH, Benzo(a)pyrene, this chemical has a B2 cancer rating and is assigned toxicity equivalency factors (TEFs) which modify the BaP slope factor (7.3/mg/kg/d) for the individual PAH.

Benzo(g,h,i)perylene TEF = 0.01* CSF = 0.073/mg/kg/d

* TEF value from Nisbett and LaGoy, 1992 which is supported by the co-carcinogenicity of this PAH with BaP (synergistic - Cherng, et al., TAP 170: 63-68, 2001) and the DNA adduct evidence (Hughes and Philips, Carcinogen 14: 127-133, 1993).

Conclusion –

The TEF for benzo(g,h,i)perylene is taken from the cited 1992 literature source, which, together with more recent evidence, supports a finding of carcinogenicity for this PAH in spite of the fact that USEPA has put this PAH into Group D (not classified as a carcinogen or non-carcinogen).

Bis-2-(Chloroethoxy)methane :

Non-cancer –

USEPA PPRTV chronic RfD (2006) of 0.003 mg/kg /day
This derivation based upon a NOAEL for liver toxicity in 90 day gavage study in rats with use of a 3000 fold cumulative UF to derive this provisional RfD.

Cancer –

Not listed as carcinogenic by IARC, NTP or USEPA
NTP 2011 conducted a 2 year dermal cancer study in rats and mice which failed to find a carcinogenic effect; mutagenicity testing found activity in the Ames test but negative results in several other tests.

Conclusion –

Use the PPRTV RfD of 0.003 mg/kg/d (2006) for APS RSR criteria development.

Bromodichloromethane

Non-cancer –

IRIS RfD (1991): 0.02 mg/kg/d
IRIS RfC: Not available

The IRIS RfD is based upon the dose response for liver and kidney toxicity in 2 year NTP gavage studies in rats and mice in which the LOAEL for renal effect in mice was divided by a cumulative 1000x UF (standard uncertainty factors plus database deficiency and LOAEL to NOAEL).

Cancer –

IRIS (1993): Oral CSF = 0.062/mg/kg/d
EPA (WQC 2015) Oral CSF= 0.034/mg/kg/d
CalEPA: Inhalation UR = 3.7E-05/ug/m3

USEPA's oral cancer assessment is based upon the NTP 2 year gavage studies in rats and mice in which liver and kidney tumors were found. The incidence of renal tubular adenoma/carcinoma in mice was used for potency calculation. The CalEPA inhalation UR derivation is not available on line but the numerical value is very similar to a direct dose route extrapolation from the oral route (2 fold more potent than a simple route calculation). Given that there are no other inhalation potency values, the CalEPA value is chosen for assessing cancer risk from inhalation exposures to this trihalomethane. The mutagenicity database is overall positive.

Conclusion –
Use the IRIS oral CSF and the California inhalation UR, which is also listed on the Region 9 RSL table.

However in July 2015 EPA released an oral toxicity value for this compound which was used to calculate the human health risk based values for consumption of fish and water. This value is the cancer slope factor of 0.034 mg/kg/day. This value was used to calculate human health risk based criteria

Bromomethane:

Non-cancer –

IRIS RfD (1991): 0.0014 mg/kg/d
ATSDR intermediate oral MRL: 0.003 mg/kg/d
PPRTV (2007) subchronic oral RfD: 0.005 mg/kg/d
DPH Assesment: RfD= 0.0005 mg/kg/day

IRIS RfD based upon subchronic gavage study in rats showing forestomach hyperplasia; 1000x UF from a NOAEL to yield the RfD (chronic value). However, using the same data a more recent analysis by the EPA Superfund Office has since derived a subchronic RfD of 0.005 mg/kg/d. Similarly ATSDR has an intermediate oral MRL of 0.003 m/kg/d based upon toxicity to the gastric epithelium and a 100 fold cumulative uncertainty factor.

Cancer –

IRIS: classification – Group D

Bromomethane is a mutagen but was negative in chronic bioassays via inhalation exposure in mice (NTP, 1992). It is also structurally related to bromoethane, which had equivocal carcinogen test results in NTP studies.

Conclusion –

The Superfund provisional subchronic value is a reasonable starting point for RfD derivation and is supported by the ATSDR intermediate MRL. Subchronic to chronic UF plus uncertainty of possible carcinogenicity (mutagen but negative results in NTP inhalation bioassay, 1992) leads to 10x lowering of the subchronic PPRTV RfD to yield 0.0005 mg/kg/d.

Butylbenzenes n-, sec, tert:

Non Cancer –

USEPA PPTRV (2010) chronic = RfD 0.05 mg/kg /day (n-butylbenzene)

USEPA PPRTV's review of n-butylbenzene toxicology identified a 2005 rat reproduction study (2 generation) in which both the F0 parents and F1 offspring developed liver enlargement (hepatocellular hypertrophy); USEPA derived a benchmark dose (BMDL) of 137 mg.kg/day This value was divided by a cumulative uncertainty factor of 1000 to derive a subchronic RfD and by 3000 to derive a chronic RfD of 0.05 mg/kg/day for n- butylbenzene. This value can be applied as well to sec- and tert-butylbenzene. PPRTV derivations for these isomers (2012) derived a similar RfD (0.1 mg/kg/d) but this was based upon using cumene as surrogate and based upon a 1956 toxicology study. This approach was characterized by USEPA as an uncertain screening value. Analogy with the structural congener n-butylbenzene is highly relevant, based upon more recent toxicology studies (2005) and thus applied for butylbenzenes in general.

Cancer –

Not available but no evidence to suggest carcinogenic effects.

Conclusion –

There are no toxicology values for the butylbenzenes on IRIS, ATSDR or California OEHHA. However, the PPRTV derivation of an oral RfD for the n-butylbenzene is based upon recent toxicology and methodologies and so is appropriate for criteria development as a chronic RfD of 0.05 mg/kg/d for the butylbenzenes in general.

Carbazole:

Non-Cancer –

IRIS: Not available
ATSDR MRL: Not available
CalEPA: Not available

Cancer –

IRIS: Not available
USEPA/HEAST: (B-2 classification) CPF = 0.02/mg/kg/d
HEAST slope factor based upon a 96 week dietary study in mice, which yielded elevated levels of liver tumors (Tsuda, et al 1982 - J NATL CANCER INST. 69: 1383-1389).
CalEPA – Not available

Conclusion –

Carbazole is a PAH with some genotoxic (e.g., Jha and Bharthi, 2002, Mut Res 500:97-101) and carcinogenic evidence (Tsuda, et al 1982) that has not been fully evaluated by the IRIS process or by other jurisdictions. However, the available evidence and HEAST entry is sufficient to set RSR targets based upon the cancer risk using the CSF of 0.02/mg/kg/d.

4-Chloroaniline:

Non-Cancer –

IRIS RfD (1995): 0.004 mg/kg/day
ATSDR MRL – Not available

The IRIS RfD was based on a NOAEL of 12.5 mg/kg/d for splenic effects in a rat chronic bioassay divided by a 3000 cumulative UF.

Cancer –

EPA PPRTV (2008) CSF = 0.2/mg/kg/d
IRIS: Not available
CalEPA: Not available

USEPA's Superfund Office derived a provisional (PPRTV) oral slope factor of 0.2/mg/kg/d based upon findings of adrenal tumors in male rats exposed via gavage for 2 years. Supporting data comes from additional tumor sites in NCI, 1979 testing in rats and NTP 1989 tumor results in mouse liver. Genotoxicity testing has shown mixed results although 4-chloroaniline was positive in a variety of test systems. IARC (1993): 2B – animal carcinogen, positive in a variety of genetic toxicity studies, including several in vitro mammalian studies. IARC declared it has sufficient evidence of cancer in animals.

Conclusion –

The PPRTV 2008 analysis provides a detailed review of the cancer and genotoxicity data as well as a quantitative analysis of cancer potency which is supported by other tumor data for this compound. This leads to an oral CSF of 0.2/ mg/kg/day.

Chloroethane:

Non-Cancer –

IRIS (1991): RfD – not available
RfC – 10 mg/m^3
USEPA PPRTV RfD (subchronic) = 0.1mg/kg/day (subchronic)
California Chronic REL: 30 mg/m3
ATSDR MRLs: only MRL available is an acute inhalation value.

The IRIS NOAEL value for developmental effects was divided by a cumulative Uncertainty Factor of 300. The USEPA PPRTV NOAEL of 361mg/kg was for subchronic effects and this value was divided by a 3000 fold uncertainty factor to for a subchronic reference dose of 0.1 mg/kg/day.

Cancer –

IRIS – no published assessments
California (2001) inhalation unit risk = 1.3E-06/ug-m^3; CalOEHHA also presents the oral equivalent potency as 0.0047/mg/kg/d by simple dose route conversion. CSF (2001) = 0.0047/mg/kg/d

IARC (1998) – Group 3 – limited evidence of carcinogenicity Chloroethane is positive in several mutagenicity tests although, overall the results are mixed.
ATSDR Toxicity Profile describes chloroethane as having positive tumor response in mouse NTP studies, primarily uterine and liver tumors. Further chloroethane is likely an alkylating agent based upon structure.

California's Proposition 65 listing determination (2001) estimated the cancer potency of chloroethane from dose-response data of uterine tumors among female mice exposed by inhalation (NTP, 1989). Both an inhalation slope (1.3E-06/ug-m3) and an oral slope 0.0047/ mg/kg/day) were calculated from this dataset.

Conclusion –

Use the Calif Prop 65 inhalation and oral cancer potency estimates from May 2001 available at http://oehha.ca.gov/prop65/law/pdf_zip/chloroethaneNSRL.pdf as the focal point of RSR calculations.

Chloromethane:

Non-Cancer –

IRIS RfD: Not available
IRIS RfC (2001): 90 ug/m3 (0.026 mg/kg/d)
ATSDR chronic inhalation MRL (1998): 100 ug/ m^3

CalEPA Chronic REL: Not available
CTDPH Assessment: Oral Rfd=0.0026mg/kg/day
Inhalation RfC=9 ug/m^3

The IRIS RfC is based upon a NOAEL for CNS lesions in a mouse 11 day inhalation study with a 1000 fold UF. ATSDR inhalation MRL is essentially the same. A dose route extrapolation to the oral route is appropriate given that this is not a portal of entry effect.

Cancer –

IRIS (2001): acknowledges some carcinogenic and mutagenic evidence but considers its MOA for mouse renal tumors as more cytotoxic than mutagenic so doesn't use low dose linear approach.
CalEPA – no cancer assessment

Asakura et al. 2008 applied an improved technique for testing highly volatile compounds in the cell culture chromosome aberration assay and found chloromethane to be of similar clastogenic potency as vinyl chloride; the authors also highlight positive in vivo genotoxicity data for chloromethane (mouse dominant lethal test) in a summary table.

Conclusion –

Use the IRIS RfC and dose route extrapolation for systemic toxicity of chloromethane to yield an RfD equivalent of 0.026 mg/kg/d. This is divided by 10 fold UF for possible carcinogenicity given that methyl chloride can form formaldehyde in vivo, is positive in a broad array of mutagenicity studies with the most recent testing showing similar potency to vinyl chloride, and it has some positive carcinogenicity results (mouse kidney tumors). This approach yields an RfD of 0.0026 mg/kg/d**.** The corresponding RfC for TAC development is 9 ug/m^3.

Chlorophenol,3-methyl-4:

Non-cancer –

ASTDR MRL (2008) = 0.1 mg/kg/day
USEPA PPRTV (2009) chronic RfD of 0.1 mg/kg/d

The PPRTV derivation is based upon a chronic dietary study in rats (Bayer 1993) which identified a LOAEL and NOAEL for male reproductive effects and conducted benchmark dose modeling; the BMD was divided by a cumulative 300 fold UF to yield 0.1 mg/kg/d.

Cancer –

Not labeled as a carcinogen by NTP, IARC or EPA. PPRTV identified one oral cancer study (Bayer 1993) – this produced negative results. Genotoxicology studies are mostly negative (PPRTV 2009).

Conclusion –

The ATSDR and PPRTV derivations both yield 0.1 mg/kg/d so this is the recommendation for application to sites needing an APS determination.

2- and 4-Chlorotoluene:

Non-cancer –

IRIS RfD (1990): 0.02 mg/kg/d
ATSDR MRL: Not available
CalEPA Chronic REL: Not available

The RfD is based upon a NOAEL for body weight effects in a subchronic gavage study in rats with a 1000 fold UF to derive a chronic RfD. Data gaps in the published literature are largely filled by unpublished studies, abstracts of which now available on the web (http://pubchem.ncbi.nlm.nih.gov/compound/2-Chlorotoluene#section=Top).

RfC: nothing available on IRIS, ATSDR, of CalOEHHA.

USEPA PPRTV – subchronic RfC (2010): 0.8 mg/m3

Rat 14 day developmental study showed maternal effects (weight gain, ataxia) for which the NOAEL was adjusted for human equivalence in exposure and then divided by UFs (300 cumulative) to generate this subchronic RfC. This can be divided further (10 fold) to estimate the chronic RfCof 0.08 mg/m^3.

Cancer –

IRIS: not evaluated
IARC: not evaluated

Conclusion –

This database is reasonably robust and the RfD of 0.02 mg/kg/d is well supported. An inhalation subchronic RfC of 0.08 mg/m3 is supported by the PPRTV analysis and happens to be nearly equivalent to the oral RfD converted to an RfC (0.07 mg/m3), although the oral and inhalation derivations were based upon different studies and UFs.

4-Chlorotoluene – use 2-chlorotoluene as surrogate which results in an RfD of 0.02 mg/kg/d.

Cobalt:

Non-cancer –

IRIS RfD: Not available
ATSDR oral MRL (subchronic, 2004): 0.01 mg/kg/d
USEPA PPRTV (2008) chronic RfD: 0.0003 mg/kg/d
CTDPH Assessment: Utilize PPRTV RfD of 0.0003 mg/kg/d

ATSDR's subchronic MRL is based upon a LOAEL (1 mg/kg/d) for RBC abnormalities in a human study involving 6 volunteers exposed orally for up to 22 days (ATSDR, 2004). The LOAEL was divided by 100 fold cumulative UF. The PPRTV 2008 derivation was based upon impairment of iodine utilization by the thyroid in humans and a 3000 fold cumulative UF to account for intr-human variability, LOAEL to NOAEL, subchronic to chronic and database deficiencies.

Cancer –

IRIS: Not evaluated
CalEPA – Not evaluated

NTP (1998) demonstrated pulmonary tumors at doses of 0.38 to 1.14 mg/m3 from chronic inhalation exposure in rats and mice. No oral tumor studies are available.

Conclusion –

Cobalt's database is relatively weak, lacking any chronic oral studies. Limited endocrine/reproductive evidence in rodents indicates that cobalt targets the testes. However, the manifestations of this effect at low dose in well designed studies are not known. Furthermore, cobalt's oncogenic potential via the oral route is unexplored. It has mixed mutagenicity data but appears to induce DNA damage and is a clastogen (ATSDR, 2004). Given this, a 10 fold UF to extrapolate the subchronic MRL to a chronic value and an additional 3 fold UF for database deficiencies is appropriate (possible carcinogen; unexplored male gonadal effects) leading to an RfD of 0.0003 mg/kg/d. This RfD is identical to the PPRTV derivation (2008), which, although based upon the thyroid as the endpoint and using a different array of uncertainty factors, came to the same RfD. Cobalt is a trace nutrient with a Recommended Daily Allowance (RDA) as part of Vitamin B12 of 0.1 ug/d (1.4E-06 mg/kg/d). The modified RfD is 200 fold above the RDA indicating that it will not inappropriately limit intake of this element.

Dibenzofuran:

Non Cancer –

ATSDR/CalOEHHA: No data
USEPA PPRTV (2007) Appendix (chronic) RfD: 0.001 mg/kg/d

USEPA's Superfund office, PPRTV program developed a provisional subchronic RfD in 2007 of 0.004 mg/kg/d based upon altered growth and increased abdominal fat in rats ingesting dibenzofuran in the diet for 200 days (study by Thomas 1940). In an appendix they further extrapolated the results from this study to a chronic RfD by applying an additional half-log uncertainty factor to yield 0.001 mg/kg/d. While this leads to a cumulative uncertainty of 10,000 fold this is warranted given the major data gaps for this chemical (no reproductive, developmental or cancer data; very limited reporting and examination of endpoints in this 200 day study).

Cancer –

No data is available, which represents a data gap. However, it was negative in bacterial mutagenicity testing and is not believed to be a mutagen.

Conclusion –

CT DPH recommends an RfD of 0.001 mg/kg/day based on the USEPA provisional subchronic reference dose of 0.004 mg/kg/day divided by a factor of three to account for chronic impacts as indicated in the PPRTV appendix for this chemical.

1,2-Dibromo-3-Chloropropane:

Non-cancer –

IRIS RfD (PPRTV 2006): 0.0002 mg/kg/d
ATSDR MRL: Not available

Cancer –

IRIS: not available, but USEPA has a provisional oral slope of 0.8/mg/kg/d (PPRTV, 2006)
CalEPA – 7/mg/kg/d (OEHHA Tech Support Doc, 2002)

Conclusion –

1,2-DB-3-CP is a mutagen and carcinogen (B2). The USEPA provisional value is based upon male rat kidney tumors while Cal OEHHA chose the mouse gastro-intestinal tract tumors as the more sensitive endpoint and yielding a higher cancer slope. Further, the CalOEHHA derivations are not considered provisional in contrast to the PPRTV values. Use of the CalOEHHA cancer slope factor provides a value of 7/mg/kg/d.

Dichlorobutene, 1,4-:

Non Cancer –

IRIS/ATSDR/CAL OEHHA: No values
EPA PPRTV RfC = 0.0042 mg/m3 (nasal irritation and damage)
EPA PPRTV RfD = 0.001 mg/kg extrapolated.

Cancer-

Oral Slope: Not available

Inhalation Slope (PPRTV 2008): 4.2E-03/ug-m^3 (rat nasal tumors)

Conclusion –

The PPRTV provides inhalation cancer and non-cancer potency estimates that are supported by a reasonable database but contact site targeting prevents dose route extrapolation to oral potency values.

Dichlorodifluoromethane:

Non-cancer –

IRIS RfD (1995): 0.2 mg/kg/d
USEPA (2010): PPRTV subchronic RfD – 0.05 mg/kg/d
ATSDR MRL: Not available

IRIS RfD based upon an oral feeding study in which there was only a body weight effect at the high dose (3000 ppm). Given the volatility of this compound, dietary feeding may not be an effective delivery method. An inhalation RfC was developed by USEPA (HEAST-alternative list) that is 4 times lower; which is based upon liver lesions in a guinea pig 6 week inhalation study. This would lead to an RfC of 0.05 mg/kg/d. This is the same value as the PPRTV subchronic RfD.

RfC: HEAST: 0.175 mg/m3
PPRTV screening RfC (2010): 0.1 mg/m3

Cancer –

IRIS: Not available
IARC: Not available
CalEPA: Not available
Negative in several genetic toxicology studies.

Conclusion –

Dichlorodifluoromethane had no discernable toxicity in the chronic oral dietary study or in related 3 generation reproduction study run in the same lab at the same time (1974, as reported in USEPA IRIS 1995); however, it is highly volatile and so some material may have been lost. The inhalation study which found liver lesions from subchronic dosing of guinea pigs may be a more reliable basis in that there is no question about compound delivery and it did find systemic effects. This is also appropriate to use, given that dichlorodifluoromethane contamination will likely lead to at least as much inhalation as oral exposure. This would suggest an RfD of 0.05 mg/kg/d. This is supported by the PPRTV 2010 derivation of a subchronic RfD of 0.05 mg/kg/d, which takes into account database uncertainties that the USEPA IRIS RfD did not consider. Therefore, the RfD of 0.05 mg/kg/d is selected for APS assessments.

The RfC of 0.1 mg/m^3 from PPRTV represents a recent analysis of the inhalation literature for dichlorodifluoromethane that is supported by the older HEAST determination.

1,1-Dichloroethane:

Non-cancer –

IRIS RfD: Not available
HEAST RfD: 0.1 mg/kg/d
ATSDR MRL: Not available

USEPA/HEAST RfD based upon dose route extrapolation from a 13-week inhalation study in rats which found no toxicity at the low dose, equivalent to 115 mg/kg/d. HEAST applied a 1000 fold UF to extrapolate to a chronic RfD.

Cancer –

IRIS: Group C, limited evidence in animals
IARC: not available
CalEPA Oral Slope (2009) = 0.0057/mg/kg/d
Only one genotoxicological study in GAP-2000 database – it was positive. It also binds to DNA. Structurally related to 1, 2-dichloroethane, a mutagen and B2 carcinogen.

NCI 1977 gavage studies of 1, 1-dichloroethane found elevations in mammary and blood vessel tumors in female rats and liver tumors in male mice. CalOEHHA derived an oral slope factor based upon the mammary tumor response.

Conclusion –

1, 1-Dichloroethane has carcinogenic potential, which is captured in the Cal OEHHA slope factor of 0.0057/mg/kg/d which is suitable for application to RSR sites.

Dichlorprop:

Non-cancer –

USEPA RfD: Not available
Other sources: Not available
CTDPH Assessment: RfD = 0.0036 mg/kg/d

Cancer –

IARC Group 2B but no slope factors available

DPH-derived RfD based upon the study by Mitsumori (1984), summarized in CA EPA (2000), which documented effects on kidney function at chronic exposures above 3.6 mg/kg/day; this dose can be considered the NOAEL. This was divided by a combined uncertainty factor of 1000 (10X for animal to human; 10X for sensitive individuals; and 10X for data gaps and possible carcinogenicity). Dichlorprop is related to another dichlorophenoxy herbicide, 2,4-D, which has equivocal cancer evidence in humans. Dichlorprop itself has limited evidence of weak genetic toxicity (clastogenic, not mutagenic) and carcinogenicity (CANTOX). IARC, 1987 considered dichlorprop a 2B carcinogen based upon human rather than animal evidence. However, the extent of testing is limited. The 1000 fold UF leads to a value **of 0.0036 mg/kg/d**. This RfD is in the same range as the IRIS RfD for 2,4-D (0.01 mg/kg/d).

References –

CANTOX Review available at:
http://www.forces.gc.ca/site/reports/defoliant/FFReports/Task_3A1_Tier3/CEI_Gagetown_Final_Report_Appendix_B_Tier_3_April_2007/B18-Dichlorprop%20Tox%20Profile.pdf

CA OEHHA (2001). Evidence of the Developmental and Reproductive Toxicity of 2,4-DP (DRAFT). Reproductive and Cancer Hazard Assessment Section, California Environmental Protection Agency.

CA EPA (2000). Summary of Toxicology data; Dichloroprop-P. Department of Pesticide Regulation, Medical Toxicology Branch; Document T020313.

Mitsumori (1984). 2,4-DP Acid (2-(2,4-dichlorophenoxy) propanoic acid); 24 month oral chronic dietary study in rats. Institute of Environmental Toxicology (Tokyo) 85/071.

Endosulfan (and related metabolites):

Non-cancer –

IRIS RfD (1994): 0.006 mg/kg/d
ATSDR chronic oral MRL (2013, draft): 0.005 mg/kg/d
CalEPA: Not available
CTDPH Assessment RfD= 0.0006mg/kg/day

IRIS RfD based upon NOAEL for body weight, kidney, and vascular effects in 2-year rat feeding study divided by 100 fold UF. ATSDR Toxicology Profile lists a subchronic MRL of 0.005 mg/kg/d based upon immune-toxic effects in rats and a chronic MRL of 0.002 mg/kg/d based upon hepatic effects in dietary (1 year) dog study using a 100 fold UF from a NOAEL. ATSDR also notes sensitive anti-androgen effects with a LOAEL of 2.5 mg/kg/d (no NOAEL identified). Recent low dose testing in rats shows female reproductive effects (implantation loss) at 0.6 mg/kg/d with a borderline LOAEL at 0.006 mg/kg/d (Milesi et al. 2015: http://www.ncbi.nlm.nih.gov/pubmed/25486513).

Cancer –

IRIS (1990): Not available
CalEPA: Not available

Endosulfan has been tested in several inadequate cancer bioassays, with mostly negative results (ATSDR, 2000). One industry-sponsored study conducted without problems in mice was also negative. However, endosulfan is positive in a variety of genetic toxicity studies, both in vitro and in vivo, and both in mutagenicity and clastogenicity studies. Therefore, there is still considerable uncertainty in this endpoint.

Conclusion –

Endosulfan is a prototypic environmental endocrine-active agent (http://www.epa.gov/edrlupvx/inventory/NOAA-SCD.html) and animal testing suggests effects on both male and female reproduction and development. Further studies on endosulfan endocrine effects are needed to better define dose response for these effects. Further, endosulfan and its environmental degredates have limited cancer data but there are positive genotoxicity studies. Therefore, a 10 fold database deficiency factor is used to adjust the USEPA RfD, creating a cumulative Uncertainty Factor of 1000 fold to derive an RfD of 0.0006 mg/kg/d. This derived RfD is further justified by the fact that it is only 10 fold below a minimal LOAEL for reproductive effects in rats as described above.

Ethanol:

Non-cancer –

IRIS RfD: Not available
ATSDR MRL: Not available
CalEPA: Not available
CTDPH: 0.067 mg/kg/d

CTDPH risk assessment (2001) developed for a drinking water comparison value is based upon LOAEL for human neurodevelopmental effects as well as level of exposure needed to increase background blood concentrations. The neurodevelopmental LOAEL was divided by 3000 to account for data gaps, possible carcinogenicity and extrapolations from LOAEL to NOAEL and across individuals. The CTDPH assessment is available upon request.

Cancer –

IRIS: Not available
CalEPA: Not available
IARC – Group 1 – human carcinogen

Epidemiology studies show association between excessive alcohol consumption and gastro-intestinal tract cancer. Animal studies are equivocal. No data are available for quantitative low dose extrapolation. CTDPH analysis uses a 10 fold UF for possible carcinogenicity.

Conclusion –

The CTDPH RfD of 0.067 mg/kg/d is applicable for use in RSR risk assessments.

Ethylene glycol:

Non Cancer –

IRIS RfD(1989) = 2.0 mg/kg/day
ASTDR subchronic MRL (2010) = 0.8 mg/kg /day

The IRIS 1989 RfD was based upon a NOAEL for chronic kidney effects in a rat study of 200 mg/kg/day with USEPA using a cumulative uncertainty factor of 100 to yield an RfD of 2 mg/kg/day. The ASTDR MRL value of 0.8 mg/kg/day is updated relative to the IRIS profile and considers the dose response from developmental and subchronic studies in rats and mice. The developmental and subchronic renal effects had a similar dose response, which ATSDR used to derive a BMDL (benchmark dose lower limit) and applied a cumulative UF of 100 to yield the subchronic MRL of 0.8 mg/kg/d.

Cancer –

Not available; unlikely to be a carcinogen

Conclusion –

The updated ASTDR subchronic MRL value of 0.8 mg/kg/day is appropriate **e**ven though it is intended for subchronic duration, it is below the chronic RfD set by USEPA (1989) with the rodent database having enough information of different study duration to indicate there is a low probability of greater toxicity with prolonged exposure. Thus, no subchronic to chronic UF is applied.

Formaldehyde:

Non-cancer –

IRIS RfD (1991): 0.2 mg/kg/d
ATSDR chronic oral MRL: 0.2 mg/kg/d
CalEPA: Not available
CTDPH Assessment: RfD- 0.02 mg/kg/day

IRIS RfD based upon 2- year drinking water study in rats in which gastro-intestinal tract and kidney damage were seen at the high dose and a NOAEL of 15 mg/kg/d was identified. This was divided by 100 to yield the RfD. ATSDR selected the same study, NOAEL and UF to derive their oral MRL.

Cancer –

IRIS: B1 for inhalation – not characterized for oral
CalEPA: oral not characterized
IARC – Group 1 – human carcinogen – however, no determination of risk from oral exposure. IARC (Vol 88, 2006) acknowledges that 4 cancer studies have been conducted in rats via the oral route (drinking water) with 3 of the 4 showing tumor increases: 2 studies showing gastro-intestinal. tract tumors and one showing hematological cancer.

Conclusion –

Formaldehyde may have less cancer potential from the oral as opposed to inhalation dose route because a portion may react in water, food or other matrices (including acid content of stomach) and not react directly with epithelial tissues. However, the evidence of gastro-intestinal tract irritation and tumors in drinking water studies as well as limited evidence of leukemia (ATSDR, 1999; IARC, 2006) provides an indication of activity via the oral route. Therefore, this uncertainty (10 fold) is combined with the IRIS RfD to yield 0.02 mg/kg/d.

n-Hexane:

Non-cancer –

IRIS RfD: Not available
IRIS RfC (2005):=0.7mg/m^3
(Oral equivalent = 0.2 mg/kg/d)
ATSDR oral MRL: Not available
ATSDR chronic inhalation MRL (1999) =0.6 ppm (2 mg/m^3)
CalEPA: Not available
HEAST RfD= 0.06 mg/kg/d
US EPA PPRTV (2009) subchronic RfD = 0.3 mg/kg/day

The hexane database is deficient with respect to long-term oral studies. Hexane metabolic activation for peripheral neuropathy occurs in the liver (ATSDR, 1999). Oral exposure may be more potent than inhalation because of first pass metabolism in the liver. Oral exposure may also lead to greater percentage absorption (50% commonly assumed for inhalation but oral may be closer to 100%). Thus, simple dose route extrapolation from the IRIS RfC may not be appropriate. The HEAST RfD (0.06 mg/kg/d) is based upon an oral gavage study in rats in which a LOAEL for peripheral neuropathy was divided by a cumulative 10000 fold UF to derive a chronic RfD of 0.06 mg/kg/d (http://rais.ornl.gov/epa/heast/table1.htm).

Cancer –

IRIS (2005): Inadequate data although genetic toxicology mostly (-)
CalEPA: not available

Conclusion –

Use the USEPA HEAST oral RfD of 0.06 mg/kg/day. This value fits with the subchronic RfD derived by PPRTV and with the expectation that oral exposure may be somewhat more neurotoxic than inhalation for hexane.

Isopropanol:

Non-cancer –

IRIS RfD: Not available
ATSDR MRL: Not available
CalEPA: Not available
CTDPH RfD: 0.33 mg/kg/d

DPH derived a value based upon the NOAEL of 100 mg/kg/d for general toxicity endpoints (organ weight effects, renal pathology) that were seen at higher doses in several reproduction studies. DPH applied a cumulate 300 fold UF (10x for intrahuman variability, 10x for animal to human extrapolation, 3x for data gaps). A structurally similar compound, isobutyl alcohol, has an IRIS RfD that is nearly identical (0.3 mg/kg/d).

Cancer –

IRIS: Not available - not tested in cancer bioassays; unlikely for significant cancer potential based upon alcohol structure

Conclusion –

The DPH RfD (0.33 mg/kg/d) is the only value available for this low toxicity alcohol. It was tested in several reproductive and developmental studies and DPH used the lowest NOAEL with a modest UF that accounts for the lack of chronic, carcinogenicity data.

4-Isopropyltoluene (p-cymene):

Non-cancer –

IRIS RfD: Not available
ATSDR MRL: Not available
CalEPA: Not available
USEPA PPRTV: reviewed in 2011 but data inadequate for RfD derivation
CTDPH RfD: 0.03 mg/kg/d

CTDPH assessment is based upon structural similarity to the alkylbenzene cumene (isopropylbenzene) which has an IRIS RfD of 0.1 mg/kg/d based upon the NOAEL for kidney effects in rats and a 1000 fold cumulative uncertainty factor. An additional 3 fold UF is used to adjust the cumene RfD for 4-isopropyltoluene on the basis of the uncertainty in extrapolating to a slightly different alkyl benzene. A cross-check of this RfD for 4-isopropyltoluene e is based upon the only repeat dose toxicology study identified, a 4 week inhalation study in rats (Lam et al. 1996; http://www.ncbi.nlm.nih.gov/pubmed/8936554). 4-Isopropyltoluene produced a dose related alteration in brain chemistry (synaptosomal protein and neurotransmitter levels) at both the low dose (50 ppm) and high dose (250 ppm). The low dose (50 ppm or 274 mg/m^3) can be seen as a LOAEL and a basis for a screening level cross-check: adjustment for 6 hour/day, 5 day/week exposure yields a human equivalent dose for continuous exposure of 59 mg/m3. Application of 3000 fold UF (10x LOAEL to NOAEL, 10x animal to human, 10x intra-human variability, and 3x subchronic to chronic yields an inhalation target of 20 ug/m^3. Dose route extrapolation can be used to convert this to an oral target dose of 6 ug/kg/d (multiplication by 20 m3/day inhaled divided by 70 kg body weight). While 4-isopropyltoluene is expected to have neurotoxic effects at high dose, use of the Lam et al. study as the sole indicator of dose response is highly uncertain due to the unusual endpoints measured which have unclear relevance to overall brain function. The PPRTV review of this study in 2011 decided to not base an RfC or RfD on this study. However, it serves a useful cross-check of the primary approach (cumene RfD divided by 3 fold UF) as it provides a preliminary indication that 4-isopropyltoluene may influence brain function in a way that would yield a lower RfD.

Cancer –

IRIS: Not available
CalEPA: Not available

Unlikely to be carcinogenic, based upon structural similarity to cumene, which, although not tested in cancer bioassays, was mostly negative in a genetic toxicity battery (USEPA IRIS file for cumene).

Conclusion –

The 4-isopropyltoluene database is very limited and on its own does not support RfD derivation. However, this chemical is likely to have key toxicological effects similar to those of the structural analogue isopropylbenzene (kidney, CNS). The DPH assessment found that an RfD of

0.03 mg/kg/d is a reasonable extrapolation from the isopropylbenzene RfD based upon the additional uncertainty in using this type of surrogate chemical and due to the limited information that can be obtained from an inhalation study conducted with 4-isopropyltoluene . It should be noted that this RfD is associated with a water concentration of 209 ug/l. This can result in an air concentration due to 4-isopropyltoluene's volatility above its odor threshold during bathing/showering. A variety of studies indicate that isopropylbenzene and also 4-isopropyltoluene 's odor becomes detectable at air concentrations in the 20-40 ppb range (USEPA, 1992: EPA/600/R-92/047). These air concentrations can be reached during a bath or shower if the water 4-isopropyltoluene concentration is in the 15-30 ug/l range. While this would not represent a significant health risk, the p-cymene odor at these water concentrations may be noticeable and lead some individuals to seek an alternative water supply.

Lithium:

Non-cancer –

IRIS RfD: Not available
USEPA PPRTV RfD (2008): 0.002 mg/kg/d
ATSDR MRL: Not available
CalEPA: Not available
CTDPH RfD: 0.002 mg/kg/d

CTDPH assessment based upon evidence of adverse effects on uterine and ovarian endpoints within human therapeutic dose range as evidenced in female rat model (Jana, et al., Reprod Toxicol 15: 215, 2001 – effect level 1.6 mg/kg/d). This LOAEL was divided by a 1000 fold cumulative UF. Similarly, PPRTV (2008) noted that renal side effects are common in the therapeutic range (bipolar disorder treatment). Converting the therapeutic blood level to an intake dose (2.1 mg/kg/d) and using a 1000 fold UF, PPRTV also derived 0.002 mg/kg/d as an RfD.

Cancer –

IRIS: Not available
CalEPA: Not available

Unlikely to be carcinogenic or mutagenic – mostly negative genetic toxicology database; mixed evidence of teratogenesis. (Leonard, et al., Mutation Res 339: 131, 1995)

Conclusion –

The PPRTV and DPH-derived RfD of 0.002 mg/kg/d is supportable based upon the clear toxicological effects in the therapeutic dose range.

Methyl Methacrylate:

Non-cancer –

IRIS RfD (1998): Oral RfD 1.4 mg/kg/d
USEPA (1998): Inhalation RfC= 0.7 mg/m^3

ATSDR MRL: Not available
CalEPA: Not available
CTDPH Assessment: Oral RfD= 0.14 mg/kg/day
Inhalation RfC= 0.07mg/m^3

IRIS RfD based upon a chronic drinking water study in rats in which no effects were seen. The high dose was considered the NOAEL and divided by 100. However, there are no reproductive or developmental toxicity studies by the oral dose route and MMA is a well-known dermal sensitizer (Betts, et al. Contact Dermatitis 55: 140-146, 2006) and is a chemical of concern to both patients and health practitioners in the dental industry (Leggat et al. 2003: http://www.ncbi.nlm.nih.gov/pubmed/12873108).

RfC based upon chronic rat inhalation study with found a dose response for degeneration of the olfactory epithelium of the nose.

Cancer –

IRIS: Not available
CalEPA: Not available

Unlikely to be carcinogenic based upon mostly negative findings in inhalation cancer bioassays – any tumorigenic effect likely related to local irritant, cytotoxic damage and regenerative hyperplasia.

Conclusion –

Methyl methacrylate is a common workplace irritant and dermal sensitizer, properties that are not accounted for in the IRIS RfD or RfC. Its test database is lacking with respect to developmental or neurological effects. These factors combine to yield an additional 10 fold UF to the RfD (adjusted to 0.14 mg/kg/d) and RfC (adjusted to 0.07/mg-m3). A closely related congener, ethyl methacrylate was reviewed by USEPA PPRTV (2010). That review derived a screening level subchronic RfD of 0.01 mg/kg/d based upon a LOAEL for neurotoxicity in a 60 day rat study. This reinforces the concept that the IRIS RfD for methyl methacrylate may be too high and there is greater uncertainty in that derivation than the 100 fold used by USEPA in 1998.

Methylnaphthalene, 1:

Non-cancer –

USEPA IRIS: Not available
ATSDR chronic MRL: 0.07 mg/kg/d

The ATSDR MRL was based upon a finding of pathological change in the lungs of mice exposed to 1-methylnaphthalene in an 81 week dietary study (Murata et al. 1993). The LOAEL for this effect was divided by a cumulative 1000x UF (10 for LOAEL to NOAEL, 10 for across species and 10 for intrahuman variability).

Cancer –

USEPA IRIS: No data
USEPA PPRTV (2008): "Suggestive Evidence of Carcinogenicity and developed an Oral slope factor = 0.029/mg/kg/d
CalEPA: Not available

1-methylnaphthalene has been tested in a small number of genetic toxicology studies which yielded mixed results and thus it is not clearly a mutagen but this possibility cannot be ruled out.

Conclusion –

The lungs are consistently a target of naphthalene and its methyl congeners with the findings of lung pathology (proteinosis) and tumor increases at both doses in male mice exposed for nearly 1.5 years sufficient evidence for USEPA PPRTV to develop an oral slope factor which is also posted on the Region 9 RSL table. This provisional slope factor (0.029/mg/kg/d) is recommended for use in RSR determinations as it will provide a more health protective basis than the ATSDR MRL which does not take into account cancer risk.

Methylnapthalene, 2:

Non-cancer –

IRIS RfD: 0.004 mg/kg/d (2003)
EPA Provisional: 0.004 mg/kg/d (cis isomer)
ATSDR MRL: 0.04 Uncertainty factor of 100

Cancer –

IRIS: Not available;
IARC: Not available
CalEPA: Not available

IRIS BMDL is set at 4.7 mg/kg/day is based on effects pulmonary alveoli and lung, this value is divided by an uncertainty factor of 1000 resulting in an RfD of 0.004 mg/kg/day.

Conclusion –

Methylnapthalene,2 has very similar toxicity values which supports the individual determinations available on IRIS, ADSTR and EPA-Provisional. There is no reason to consider the RfD listed above to be different from each other. For current purposes, DPH uses the IRIS value of 0.004 mg/kg/d.

2- and 4-Methylphenols (o- and p-Cresols):

Non-cancer –

IRIS RfD (1990): 0.05 mg/kg/d for 2-methylphenol
ATSDR oral MRL: 0.1 mg/kg/d for methylphenol mixtures
USEPA PPRTV Rfd (2010): 0.02 mg/kg/d

IRIS RfD based upon a 90 day gavage rat study in which a neurotoxicity NOAEL was identified and was divided by 1000 fold to extrapolate to chronic and animal to human and inter-individual variability. The ATSDR intermediate oral MRL is based upon 28 day and 90 day dietary studies (NTP, 1992) in which 3- and 4- methylphenols caused histopathological changes to the nasal epithelium as the most sensitive finding. ATSDR applied a 100 fold UF to the benchmark dose. This MRL is based upon dietary rather than gavage studies; the latter has shown greater cresol toxicity. The USEPA PPRTV NOAEL of 0.02 mg/kg/day focuses upon the gavage data, which includes a developmental study in rabbits with found a NOAEL for maternal toxicity of 5 mg/kg/d and a 300 fold cumulative UF.

Cancer –

IRIS (1990/1992): Group C for both 2- and 4-methylphenol NTP 2008 report on 2 year bioassays in rats and mice with a 60:40 mixture of 3- and 4- methylphenol found equivocal evidence of carcinogenicity in the male rat kidney (adenomas) and some evidence of cancer induction in the mouse forestomach. Quantitative estimates of cancer potency have not been calculated based upon these findings. 4-methylphenol is positive in the mouse lymphoma assay and several other genetox or promoter assays, but negative in bacterial mutagenicity studies; on balance not likely to be a potent mutagen.

Conclusion –

The updated PPRTV assessment (2010) has the benefit of recent chronic testing by NTP (2008) and a variety of other studies not available to IRIS in 1990. Thus, this updated value is the most reliable basis for RfD selection and so an RfD of 0.02 mg/kg/d is recommended.

3-Methylphenol (m-Cresol):

Non-cancer –

IRIS RfD (1990): 0.05 mg/kg/d
ATSDR oral MRL (subchronic): 0.1 mg/kg/d
CTDPH Assessment: RfD = 0.017mg/kg/day

IRIS RfD from a 90 day rat gavage study that showed body weight and neurotoxicity effects; USEPA used a 1000 fold UF from the NOAEL of 50 mg/kg/d. ATSDR's subchronic MRL is based upon a 1992 NTP study in rats involving mixed 2-/4-methylphenol dietary exposure. A variety of toxic effects were found with pathological changes in the nose the most sensitive effect. However, this may be from 2-/4-methylphenol off-gassing and not a systemic effect. The MRL derivation used benchmark dose analysis and a 100 fold UF from the benchmark dose.

Cancer –

IRIS: Group C (1991
CalEPA – not evaluated

IRIS Group C listing based upon limited evidence of skin tumor promotional activity and mixed results in genetic toxicology studies.

Conclusion –

3-Methylphenol has undergone very limited cancer testing and given some indication of potential genetic toxicity and activity as a skin promoter, a threefold UF is applied to yield 0.017 mg/kg/d.

Methyl-t-Butyl Ether (MTBE):

Non-cancer –

IRIS RfD: Not available
USEPA IRIS Inhalation RfC = 0.86 mg/kg/d
ATSDR intermediate oral MRL (1999): 0.3 mg/kg/d
CT DPH Risk Assessment (1999): 0.01 mg/kg/d

ATSDR MRL based upon a minimal LOAEL of 100mg/kg/d for liver and kidney effects in rats gavaged for 90 days, using a 300 fold UF. CTDPH utilized the same study but considered the 100mg/kg/d dose a NOAEL and applied a 1000 fold UF for non-cancer effects and uncertainties (10 for animals to humans, 10 for variability, 10 for subchronic to chronic) and an additional 10 for potential carcinogenicity.

Cancer –

IRIS: Not available
USEPA (other value): 0.004/mg/kg/d
CalEPA: 0.0018/mg/kg/d
IARC: Group 3

MTBE was positive in several rat and mouse cancer bioassays at multiple sites (mouse liver, male rat kidney and leydig cell tumors). Mostly negative genetic toxicology data; questionable whether low dose linear slope approach is appropriate.

Conclusion –

CTDPH risk assessment takes into account MTBE cancer potential with an additional UF appropriate for an IARC Group 3 chemical yields an RfD of 0.01 mg/kg/d. The risk assessment document is available on request.

Naphthalene:

Non-cancer –

IRIS RfD (1998): 0.02 mg/kg/d
IRIS RfC (1998): 0.003 mg/m3 (0.00086 mg/kg/d oral equivalent)
ATSDR MRL: Not available
CTDPH Assessment: RfD= 0.002mg/kg/d

IRIS RfD based upon a 90 day gavage rat study in which decreased body weight was the most consistent and sensitive effect. No NOAEL was identified. The LOAEL was divided by 3000 fold. IRIS RfC based upon nasal inflammation in mice LOAEL divided by 3000 as discussed below, naphthalene is a possible carcinogen by the oral route and a proven carcinogen by the inhalation route. This information is taken into account in the DPH assessment.

Cancer –

IRIS (1998): Group C
NTP (1992) studies found benign respiratory tumors in mouse inhalation studies with one carcinoma detected. Follow-up NTP studies in rats (2000) found increased nasal tumors, with NTP's assessment of clear evidence of carcinogenicity. Naphthalene is negative in genetic toxicology testing.
IARC (2002): Group 2B
CalEPA (2004): 0.12/mg/kg/d (based upon NTP inhalation studies) Since this cancer unit risk is based upon a contact site effect, this potency is not extrapolated to the oral dose route. Instead, the potential for cancer by the oral route is addressed with an additional UF.

Conclusion –

The IRIS RfD is lowered 10 fold for possible carcinogenicity as evidenced by the Group C (USEPA)/Group 2B (IARC) designations and the fact that an inhalation slope factor has been developed by CalEPA. Chronic oral studies for naphthalene carcinogenicity have not been conducted, with the exception of a 1955 study of limited value. 1-methylnaphthalene is carcinogenic (lung tumors) by the oral dose route and EPA Region III RBC table now has a provisional CSF for this compound of 0.029/mg/kg/d. Lowering the RfD by 10 fold for possible carcinogenicity yields 0.002 mg/kg/d. It should be recognized that the RfC is well below the RfD due to local effects on respiratory tissues. Since naphthalene is volatile, the standard GWPC RSC may not be sufficient to account for inhalation exposure from bathing/showering and household water use.

Nitroanilines, 2-, 3-, and 4-:

Non-cancer –

IRIS RfD: Not available
USEPA PPRTV (2009) RfD: 0.004 mg/kg/d – 4-nitroaniline
ATSDR MRL: Not available

Cancer –

USEPA PPRTV (2009) CSFs: 0.02/mg/kg/d
CalEPA : Not available

Conclusion –

Apply the provisional cancer slope factor developed by USEPA for the 4- isomer of 0.02/mg/kg/d to all three nitroanilines. 4-nitroaniline is the prototype in this series having the greatest amount of test data. Aniline is carcinogenic and nitrobenzene is a 2B IARC carcinogen, so nitroanilines can be expected to also be carcinogenic.

Nitrobenzene

Non-cancer -

IRIS RfD: 0.002 mg/kg/d (2009)
ATSDR MRL: No data

The IRIS RfD is based upon the BMDL of 1.8 mg/kg/day from a subchronic (gavage) rat study for which the key endpoint was increased methemoglobin levels. An uncertainty factor of 1000 was applied for animal to human and intra-human variability, as well as 3 fold to cover database deficiencies and 3 fold for the subchronic to chronic extrapolation. USEPA assessed that a full 10 fold factor for subchronic to chronic was not needed based upon longer term studies with nitrobenzene for the inhalation route. This yields a reference dose of 0.002 mg/kg/day.

Cancer –

IRIS: Not available by the oral route; inhalation unit risk = 4E-05/ug-m^3
CalEPA: No quantitative information but nitrobenzene was labeled a carcinogen under Prop 65 in 1997.
CTDPH Assessment: Oral slope factor – 0.14 mg/kg/d (extrapolated to oral from the IRIS inhalation unite risk).

Conclusion – The IRIS RfD is a good starting point but the lack of cancer testing for the oral dose route combined with positive cancer bioassays in both rats and mice by the inhalation route indicates an uncertainty with regards to cancer for oral exposures to nitrobenzene. The cancer targets are varied and include the liver, thyroid and kidney and so this is not a contact site portal of entry type agent. This makes dose route extrapolation from the inhalation to oral results feasible. The 2009 IRIS profile recognizes the potential for carcinogenesis by the oral route but states that a quantitative approach is not possible until pharmacokinetic models are developed. However, without further information a reasonable default is to apply the inhalation slope to the oral dose route as well. Thus, DPH recommends applying the inhalation slope (4E-05/ug/m3) to the oral route with dose route conversion.

N-Nitrosodimethylamine:

Non-cancer –

Not relevant – risk driven by cancer potency

Cancer –

IRIS (1991): 51/mg/kg/d Group B2

CalEPA (2002): 16/mg/kg/d

IRIS CPF based upon rat liver tumors from chronic drinking water ingestion. NDMA is a potent carcinogen and mutagen. CalEPA based their calculations upon the same study, although they also calculated potency from four additional studies.

Conclusion –

The CalEPA CSF of 16/mg/kg/d is best supported and most recently updated and is used in place of the IRIS cancer potency value.

Pentachloronitrobenzene:

Non-cancer –

IRIS RfD (1992): 0.003 mg/kg/d
ATSDR MRL: Not available
CTDPH Assessment RFD= 0.001mg/kg/day

IRIS RfD based upon a 2 year dog feeding study in which the NOAEL for liver toxicity was divided by a 300 fold UF to derive the RfD.

Cancer –

IRIS (1998): Not available
USEPA (HEAST): 0.26/mg/kg/d
IARC (2002): Group 3
CalEPA: Not available

Basis for HEAST slope factor is unknown but IARC (1974) reports suggestive animal tumor results in skin and oral studies. NTP 1978 dietary studies were negative in rats and mice. Genotoxicity data are mixed with negative mutagenicity in mammalian and bacterial systems and negative sister chromatid exchange but it was positive in the in vitro chromosomal aberrations assay (NTP 1987).

Conclusion –

The IRIS RfD is lowered 3 fold for possible carcinogenicity as evidenced by the slope factor which still exists on HEAST (and appears on current USEPA regional screening level table although decreasing the concern are the negative results seen in NTP 1978 dietary studies. Threefold lowering of the RfD yields 0.001 mg/kg/d.

n-Propylbenzene:

Non-cancer` –

IRIS RfD: Not available
ATSDR MRL: Not available
CalEPA: Not available
USEPA PPRTV (2009-Appendix): screening RfD= 0.1 mg/kg/d

PPRTV (2009) reviewed the toxicology database for n-propylbenzene and found it inadequate for RfD or RfC derivation. However, the PPRTV appendix for this chemical derived a screening level RfD of 0.1 mg/kg/d based upon analogy with two similar alkyl benzenes, isopropylbenzene (same number of carbons, isopropyl instead of n-propyl side chain) and ethylbenzene (one less carbon in the side chain). Both of these alkyl benzenes have IRIS based RfDs of 0.1 mg/kg/d.

Cancer –

IRIS: Not available - not tested in cancer bioassays; isopropylbenzene has also not been tested in cancer bioassays but was negative in limited genotoxicity studies; ethylbenzene was also negative in genotoxicity studies but had some evidence of carcinogenicity in chronic animal studies and has been assigned cancer potency values by CalOEHHA and as listed on the USEPA RSL table.

Conclusion –

The PPRTV provisional screening RfD (0.1 mg/kg/d) is a reasonable value for n-propylbenzene for non-cancer effects; there is too little information on the basis or significance of ethylbenzene carcinogenic responses to allow extrapolation to n-propylbenzene; in any case n-propylbenzene is unlikely to be a mutagen.

Propylene Glycol:

Non-cancer –

IRIS RfD: Not available
USEPA PPRTV RfD (2008) = 20 mg/kg/day
ATSDR MRL: Not available

USEPA has a provisional value that generally agrees with its close structural analogue, ethylene glycol, IRIS RfD of 2 mg/kg/d. The reproductive toxicology of propylene glycol has been extensively reviewed and found to not be a developmental or reproductive toxicant (NTP/CERHR, 2003). PPRTV identified a NOAEL of 5200 mg/kg based on reduced RBC counts and hyperglycemia. An uncertainty factor of 300 was applied resulting in an RfD of 20 mg/kg (rounded up from 17.3 mg/kg).

Cancer –

There are no cancer concerns with this chemical.

Conclusion –

Apply the provisional USEPA RfD of 20 mg/kg/d based upon PPRTV 2008.

Pyridine:

Non-cancer –

IRIS RfD (1989): 0.001 mg/kg/d
ATSDR MRL (1993): reviewed but no MRL set due to data gaps
CTDPH Assessment RfD= 0.0003 mg/kg/day

IRIS RfD is based upon a 90 day gavage rat study in which the main effect was liver weight changes, with the RfD based upon the NOAEL divided by 1000 (10x animal to human, 10 for variability, 10 for subchronic to chronic). There was no UF for data gaps in spite of the recognized gaps in reproductive, developmental and cancer testing.

Cancer –

IRIS: No evaluation
NTP (2000): 2 year drinking water studies in rats and mice yielded clear evidence of carcinogenicity in mouse liver (both sexes) and some or equivocal evidence of carcinogenicity in male rat kidney and female rat leukemia. For example the liver carcinoma response in female mice was: control, 15, 35 or 70 mg/kg/d -- 13/49, 23/50, 33/50, 41/50. Genotoxicity testing by NTP was negative across several different test systems.
(http://ntp.niehs.nih.gov/results/pubs/longterm/reports/longterm/tr400499/abstracts/tr470/index.html)

Conclusion –

The IRIS RfD is lowered 3 fold for extensive data gaps as described in the IRIS file and ATSDR toxicity profile. The IRIS file expressed specific concern about neurotoxic effects seen in occupational studies, with this not assessed in animal experiments. Carcinogenicity testing by NTP shows clear evidence in mouse liver but to date cancer potency values have not been calculated and the genotoxicity data are negative. Use of a 3 fold uncertainty factor covers the data gaps in reproductive and developmental testing areas and the uncertainty created by the oncogenic effect in mouse liver. The modified RFD is thus 0.0003 mg/kg/d.

Styrene:

Non-cancer –

IRIS RFD (1990): 0.2 mg/kg/d
IRIS RfC (1990): 1 mg/m3 (0.29 mg/kg/d oral equivalent)
ATSDR intermediate MRL (1992): 0.2 mg/kg/d
CTDPH Assessment: RFD=0.02 mg/kg/day

IRIS RfD based upon a gavage study involving groups of 4 dogs exposed for 560 days, with the NOAEL for hematologic and liver effects divided by 1000 (standard 10x factors plus one for subchronic to chronic). ATSDR identified a rat study in which hepatic effects were found at a LOAEL of 200 mg/kg/d, which is the NOAEL from the dog study EPA used as the basis for the RfD. This leads to an intermediate duration MRL of 0.2 mg/kg/d as developed by ATSDR with a 1000 UF to account for extrapolation from a LOAEL to NOAEL in addition to the standard factors.

Cancer –

IRIS: Not available
IARC (2002): Group 2B, limited evidence in humans and animals
CalEPA: Not available, but in 2013 CalOEHHA derived a drinking water PHG of 0.5 ug/L based upon *de minimus* cancer risk.

Styrene forms styrene oxide in vivo and this leads to cytogenetic damage, DNA adducts, mixed mutagenicity results and increases in pulmonary tumors in mice chronically exposed via inhalation. However, oral studies in rats have been negative**.**

Conclusion –

The ATSDR intermediate MRL of 0.2 mg/kg/d relies upon a more robust test and sensitive endpoint (liver toxicity in rats as opposed to a study of a small number of dogs) to yield an intermediate MRL that is numerically equivalent to the IRIS chronic RfD. Division of the intermediate MRL by 3 to extrapolate to chronic and by 3 for possible carcinogenicity yields a value of 0.02 mg/kg/d. Styrene has genotoxic potential and limited evidence of tumor genesis in chronic testing which supports a Group C classification and added UF for possible carcinogenicity. The IARC 2B classification was initially developed in 1994 and reconfirmed in 2002.

t-Butyl Alcohol (TBA):

Non-cancer –

IRIS RfD: Not available
ATSDR MRL: Not available
CTDPH (2004): 0.017 mg/kg/d

CTDPH value based upon the LOAEL for female rat kidney effects of 175 mg/kg/d as found in an NTP chronic drinking water study. This was divided by uncertainty factors for LOAEL to NOAEL, animal to human, inter-individual variability and 10 fold for possible carcinogenicity.

Cancer –

IRIS: Not available
IARC: Not available
CalEPA: Not available

NTP (1995) tested TBA in rats and mice in 2-year drinking water studies. There were increases in male rat kidney and female mouse thyroid tumors. These tumor target sites are the same as for MTBE; TBA is a metabolite of MTBE. NTP found that this constitutes "some evidence of carcinogenic effect". TBA was not genotoxic in a battery of 5 tests administered by NTP. Slope factors for TBA's carcinogenic potential have not been developed.

Conclusion –

The CTDPH risk assessment from 2004 is available upon request. It documents the development of a non-cancer target of 0.017 mg/kg/d, which is suitable for use in the RSR program. This value is very close to the value derived for MTBE.

Tetrahydrofuran:

Non-cancer –

IRIS (2012) RfD: 0.9 mg/kg/d
ATSDR MRL: Not available
CalOEHHA: Not available

IRIS 2012 RfD assessment based upon a 2 generation drinking water study in rats in which decreased pup weight gain was the endpoint used for quantitative dose response assessment and RfD derivation. A cumulative 1000 fold UF was used.

Cancer –

IRIS 2012: inhalation unit risk = 3E-06/ug/m3 or 0.01/mg/kg/d as per dose route conversion
USEPA's summary assessment: "suggestive evidence of carcinogenic potential", EPA derives a cancer potency estimate but only in Appendix B and then cautions about using it. IARC: 2B
CalEPA: Not available
PPRTV: (recently removed): 0.0076/mg/kg/d

A 2 year inhalation bioassay of THF in rats and mice (NTP 1998) found dose related increases in female mouse liver and male rat kidney tumor responses. Mechanism of action questions were raised about the relevance of these findings to humans (male rat kidney might have involved alpha mu2 mechanism) and to low dose (female mouse liver tumors may have been spurred by cytotoxicity and cell proliferation). These mechanisms were promoted in particular because of the negative results in genotoxicity studies for THF and the IRIS document discusses the possibility that a linear low dose extrapolation may overestimate cancer potency at environmental exposures. However, the dose response patterns were statistically significant, the mechanistic hypotheses are not robust and remain unproven (as described in the IRIS file) and there is some evidence for THF-related DNA adducts (an in vitro study by Hermida et al. 2006: http://www.ncbi.nlm.nih.gov/pubmed/?term=hermida+tetrahydrofuran). The IRIS review did include derivation of a cancer potency inhalation unit risk in an appendix to show the potential risk stemming from the female mouse liver data. This potency estimate (0.01/mg/kg/d) is very similar to the provisional slope factor (0.0076/mg/kg/d) that had been on PPRTV prior to the IRIS 2012 review.

Conclusion –

Utilize the IRIS Appendix B slope factor of 0.01/mg/kg/d, which is further supported by the provisional slope factor that pre-existed the IRIS assessment.

Tin (Inorganic):

Non-cancer –

IRIS RfD: Not available
USEPA HEAST: 0.6 mg/kg/d
ATSDR intermediate oral MRL (2005): 0.3 mg/kg/d=
CT DPH Assessment: 0.01 mg/kg/d as per ATSDR intermediate MRL (0.3 mg/kg/d) divided by 10 for subchronic to chronic and 3 fold for additional database uncertainties.

ATSDR intermediate MRL based upon a NOAEL for hematological effects in rats fed tin-containing diets for 13 weeks, using a cumulative 100 fold uncertainty factor (10 for cross-species and 10 for inter-individual extrapolations).

DPH's review identified a chronic drinking water study in rats (Schroeder, et al., 1968, as cited in ATSDR, 2005) in which a single dose level (0.7 mg/kg/d) was examined. This was an unusual study in that it involved complete life observation, out to 42 months of exposure. There was a statistically increased incidence of fatty degeneration of the liver and vacuolar changes in renal cells in the tin-exposed group relative to controls. However, this LOAEL is incompatible with a NOAEL of 164 mg/kg/d for rats and mice in NTP, 1982 studies. That study failed to find any chronic toxicity other than possible carcinogenicity (see below). Differences in length of study and mode of tin administration may have to do with these divergent results.

Cancer –

IRIS: Not available
IARC: Not available
CalEPA: Not available

An NTP, 1982 dietary study in rats and mice yielded equivocal results as tin was associated with liver cancer and lymphoma in mice and possibly also lung adenomas in rats. However, results were marginal with respect to historical controls and NTP concluded that tin was not carcinogenic in these studies. Genotoxicity studies were mixed but with enough positive findings in mammalian cytogenetic and DNA damage assays to indicate that a potential genetic risk.

Conclusion –

There are two different approaches to deriving an RfD for inorganic tin. Divide the ATSDR intermediate MRL by 10, which yields 0.03 mg/kg/d. Alternatively, one could divide the chronic LOAEL from Schroeder (0.7 mg/kg/d) by 1000 (10x LOAEL to NOAEL, 10x animal to human, 10 for inter-individual variability). This yields 0.0007 mg/kg/d. However, the latter approach is not supported by the NTP chronic drinking water study or by the ATSDR subchronic MRL. Therefore, the most prudent approach is to factor additional uncertainty into the ATSDR MRL-based RfD and divide it by an additional 3 fold factor due to possibility that chronic toxicity is considerable (Schroeder evidence) and since cancer results are equivocal. This yields 0.01 mg/kg/d. This risk-based value is in a similar range as background exposure to tin in the diet, primarily coming from canned foods (0.005 to 0.1 mg/kg/d) (ATSDR, 2005).

Trichloro-1,2,2-trifluoroethane, 1,1,2- (CFC-113):

Non-cancer –

IRIS RfC (1996):
RfD: 30 mg/kg/d, converted from RfC (USEPA 1996)
ATSDR MRL: Not available
CalEPA (1997) PHG: 4 mg/kg/d
CTDPH Assessment: Rfd = 3mg/kg/day

IRIS RfC based upon an occupational study of 50 workers exposed to an average concentration of 5358 mg/m^3 for an average of 2.8 yrs. This exposure level was a NOAEL, which was divided by 10 for variability and extrapolated to an RfD by dose conversion.

CalEPA PHG determination based upon a LOAEL for mild hepatotoxicity in rats chronically exposed via inhalation. The LOAEL was divided by 300 by CalEPA.

Cancer –

IRIS: Not available
IARC: Not available
CalEPA: Not available

Not expected to be a cancer hazard as CFCs generally devoid of this activity.

Conclusion –

The IRIS RfD is divided by 10 based upon extensive data gaps, including the fact that very little testing has been done via the oral route. This yields 3 mg/kg/d, which is similar to the value derived by CalEPA.

1,2,4-Trichlorobenzene:

Non-cancer –

IRIS RfD (1996): 0.01 mg/kg/d
ATSDR MRL: Not available

IRIS RfD based upon the NOAEL for adrenal weight and adrenal histopathological changes in a 2 generation drinking water rat reproduction study. EPA divided the NOAEL by 1000, the standard UFs and an extra 10 fold to account for the lack of chronic data.

Cancer –

IRIS (1991): Group D
IARC: Not available
CalEPA (1999): 0.0036/mg/kg/d
USEPA PPRTV (2009): 0.029/mg/kg/d

IRIS review focused on an equivocal skin painting study from 1982. However, CalEPA identified an industry-sponsored dietary study (CMA, 1994) which showed clear evidence of carcinogenicity in male and female mouse liver, but not in rats. The mouse tumor dose response yielded the slope factor indicated above. Negative in most genetic toxicology studies (CalEPA, PHG, 1999). An updated assessment is available from USEPA's Superfund office as a provisional cancer slope factor of 0.029/mg/kg/d. This value is based upon the same CMA dietary study as used by Cal EPA but uses current USEPA approaches at benchmark dose analysis, human equivalent dose and low dose extrapolation.

Conclusion –

Use the PPRTV oral slope factor of 0.029/mg/kg/d for RSR calculations.

Trichlorofluoromethane (Freon 11)

Non-cancer –

IRIS RfD: 0.3 mg/kg/d
IRIS RfC: Not available
USEPA HEAST RfC(1997) = 700 ug/m^3
USEPA PPRTV subchronic RfC(2009) = 1000 ug/m^3
ATSDR MRL: Not available

The USEPA RfD is from 1987 is based upon decreased survival in rats in a National Cancer Institute (NCI, 1978) gavage cancer bioassay. The LOAEL for decreased survival was divided by a cumulative uncertainty factor of 1000. The HEAST RfC can be found on a HEAST listing from 1997 but the derivation is likely from an earlier year. It is from a subchronic inhalation study Jenkins et al. (1970) based upon increased blood urea nitrogen (BUN) in exposed dogs (LOAEL = 1008 ppm (5746 mg/$m^{3)}$, single dose level study). USEPA HEAST derived a subchronic RfC of 7000 ug/m^3 and divided by 10 to yield the chronic RfC of 700 ug/m^3. The PPRTV (2009) derivation is only for a subchronic RfC based upon studies by Stewart et al. (1975,1978) in a group of human volunteers at a single dose level for 2-4 weeks duration. USEPA PPRTV applied a 1000 fold cumulative UF to the LOAEL from that study (CNS effects).

Cancer –

IRIS: Not available

Testing by NCI 1978 and by the Maltoni et al. 1988 did not find a carcinogenic effect. Trichlorofluoromethane is not mutagenic.

Conclusion –

The HEAST RfC of 700 ug/m3 is consistent with the recent derivation of a subchronic RfC by PPRTV as it is slightly below the subchronic value and the chronic testing for cancer by NCI (1978) in gavage studies did not find effects suggesting the need for a lower RfC. Therefore, the HEAST RfC of 700 ug/m^3 is recommended for use for this compound.

Trimethylbenzenes (1,2,4- and 1,3,5-):

Non-cancer –

IRIS RfD: draft Toxicological Assessment: 2013 – 0.02 mg/kg/d for both isomers
IRIS RfC: draft Toxicological Assessment, 2013: 0.05 mg/m^3
ATSDR MRL: Not available
CalEPA: Not available

USEPA's draft tox assessment (2013) has derived oral and inhalation RfD/RfCs for the TMBs based upon neurodevelopmental testing, subchronic protocol with dose response identified for sensitive endpoints. The RfD is based upon an extrapolation from the RfC. These analyses supersede earlier PPRTV provisional values for the TMBs. Although only a draft IRIS assessment, USEPA's Science Advisory Board (2014) has agreed with this assessment and it appears likely these values will go forward. Details can be found at: http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=254525 .

Cancer –

IRIS: Not available
CalEPA: Not available

Unlikely to be carcinogenic based upon other alkyl benzenes

Conclusion –

Use of the IRIS 2013 draft values is appropriate at this point.

Vanadium:

Non-cancer –

IRIS RfD: Not available
USEPA "E"-based internal RfD: 0.001 mg/kg/d
ATSDR intermediate oral MRL (1993): 0.003 mg/kg/d
CalEPA: Not available

The ATSDR intermediate MRL is based upon the NOAEL for mild renal effects in a 3 month drinking water study in rats.

Cancer –

IRIS: Not available
CalEPA: Not available

Vanadium has some indication of positive genotoxicity but has been negative in two oral chronic studies in laboratory animals (ATSDR, 1993).

Conclusion –

The USEPA internal RfD is supported by the subchronic MRL as it is 3 times higher. Without further information to go on, the USEPA internal RfD of 0.001 mg/kg/d is suitable for RSR calculations.

Vinyl Acetate:

Non-cancer –

IRIS RfD: Not available;
USEPA HEAST RfD: 1.0 mg/kg/d
IRIS RfC: 0.2 mg/m3
ATSDR intermediate inhalation MRL (1992): 0.01 ppm (0.035 mg/m^3)
CalEPA: inhalation Reference Exposure Level = 0.2 mg/ m^3
CTDPH Assessment: RfD via extrapolation from IRIS RfC = 0.057 mg/kg/d
Inhalation RfC = 0.02mg/m^3

The inhalation toxicity values are based upon several VA rodent inhalation studies in which the primary effect was extrathoracic (nasal) toxicity. The IRIS RfC is based upon a 30 fold cumulative uncertainty factor from a NOAEL for respiratory tract toxicity. Documentation to support the HEAST oral RfD value of 1 mg/kg/d could not be found.

Cancer –

IRIS: Not available
CalEPA: Not available

IARC (1997) has rated VA as a 2B carcinogen based upon positive test data by inhalation (nasal tumors) in a chronic rat inhalation study and the supporting evidence of in vitro and in vivo genotoxicity (systemic sites from in vivo exposure) and the fact that VA is metabolized to acetaldehyde.

Conclusion – The HEAST RfD is less well supported and documented than the IRIS RfC and so the temptation is to use the RfC and dose route extrapolation to construct the RfD. However, caution is required because the RfC is based upon local effects in the nose and the oral studies available suggest less toxicity than inhalation exposure. Further rationale for relying upon the RfC for RSR criteria is the concern that vinyl acetate is highly volatile and so that any contaminated media will involve both oral and inhalation exposure. The IRIS RfC is better supported than the ATSDR MRL because it is based upon chronic rather than subchronic data and takes into account animal to human differences in regional deposited dose from inhalation exposure. A 10 fold UF is used to account for the evidence of carcinogenicity by the inhalation route to adjust the RfC to 0.02 mg/m^3 (20 ug/m^3). However, the unadjusted RfC (200 ug/m^3 is used to extrapolate to the oral dose route and RfD derivation since the nasal tumors seen via inhalation may be route-specific. Therefore, the RfC-based RfD is 0.057 mg/kg/d.

Appendix B: Connecticut Tier 2 Aquatic Life Benchmarks Supporting Documentation

Derivation of Freshwater Aquatic Life Criteria

Chemical Acetonitrile (CAS #75058)

Criteria (ug/L)	
Acute:	73,704.61
Chronic:	8,189.40

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes							
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis machrochirus	96 hour LC50	1,850,000	1,850,000	1,850,000	3	923
		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	1,640,000				12,448
	Pimephales promelas	96 hour LC50	1,000,000				923
	Pimephales promelas	96 hour LC50	1,000,000	1,179,274	1,179,274	1	923
	Poecilia reticulata	96 hour LC50	1,650,000	1,650,000	1,650,000	2	923
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	3,600,000				13,070
		48 hour EC50					
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)	Asellus intermedius	96 hour LC50					
	Gammarus fasciatus	96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)							
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)	Limbriculus variegatus	96 hour LC50					
	Helisoma trivoivis	96 hour LC50					
H: A family in any order of insect or any phylum not already represented	Dugesia tigrina	96 hour LC50					

Lowest GMAV	1,179,274
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	147,409
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Aldicarb (CAS #116063)

Criteria (ug/L)	
Acute:	8.46
Chronic:	0.94

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	560				6,797
	Oncorhynchus mykiss	96 hour LC50	660				6,797
	Oncorhynchus mykiss	96 hour LC50	560	591.53	591.53	3	18,085
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis machrochirus	96 hour LC50	450				942
	Lepomis machrochirus	96 hour LC50	71				6,797
	Lepomis machrochirus	96 hour LC50	52	118.44	118.44	1	6,797
	Ictalurus punctulatus	96 hour LC50	45000	45,000	45,000	6	18,085
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	1370				15,169
	Pimephales promelas	96 hour LC50	861				3,217
	Pimephales promelas	96 hour LC50	1370	1,173	1,173	4	344
	Carassius auratus	96 hour LC50	7400	7,400	7,400	5	12,840
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	75				18,476
	Daphnia magna	48 hour EC50	410.7				344
	Daphnia magna	48 hour EC50	583	261.87	261.87	2	18,996
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)							
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)							
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	118.44
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	16.92
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Benzoic Acid (CAS #65850)

Criteria (ug/L)	
Acute:	8,063
Chronic:	900.8

Data Requirements 1: Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50					
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Gambusia affinis	96 hour LC50 96 hour LC50	180,000			2	508
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Xenopsis laevis	96 hour LC50	129,000			1	17,379
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	860,000			3	80,404
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)							
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					
Unused Data:							
		96 hour LC50					

Lowest GMAV	129,000
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	16,125
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Carbazole (CAS #86748)

Criteria (ug/L)	
Acute:	47.72
Chronic:	5.30

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important		96 hour LC50					
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	930				17,138
	Pimephales promelas	96 hour LC50	1,140				17,138
	Pimephales promelas	96 hour LC50	1,490				17,138
	Pimephales promelas	96 hour LC50	1,500	1,241	1,241	1	17,138
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	3,350	3350	3350	2	17,138
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)							
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)							
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	1,241
Number of data requirements satisfied	2
Select Secondary Acute Factor	13
Secondary Acute Value	95.44
ACR	18

Derivation of Freshwater Aquatic Life Criteria
4-Chloroaniline (CAS #106478)

Criteria (ug/L)	
Acute:	8.89
Chronic:	0.99

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorynchus mykiss	96 hour LC50	11000				3,485
	Oncorynchus mykiss	96 hour LC50	14000				939
		96 hour LC50		12,410	12,410	3	
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Ictalurus punctatus	96 hour LC50	23000	23,000	23,000	4	939
	Lepomis macrochirus	96 hour LC50	2400	2,400	2,400	2	939
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	32500	32,500	32,500	5	15,031
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	310				846
	Daphnia magna	48 hour EC50	50	124.50	124.50	1	5,375
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	124.50
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	17.79
ACR	18

Derivation of Freshwater Aquatic Life Criteria
2-Chlorophenol (CAS #95578)

Criteria (ug/L)	
Acute:	375.75
Chronic:	41.75

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV
A: The family Salmonidae in the class Osteichthyes		96 hour LC50				
B: One other species, warm water, commercially/recreationally important	Lepomis macrochirus	96 hour LC50	6,600			
- Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	10,000	8,124	8,124	2
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Carassius auratus	96 hour LC50	12,370	12,370	12,370	4
	Pimephales promelas	96 hour LC50	9,410			
	Pimephales promelas	96 hour LC50	11,000			
	Pimephales promelas	96 hour LC50	13,000			
	Pimephales promelas	96 hour LC50	13,800			
	Pimephales promelas	96 hour LC50	9,410			
	Pimephales promelas	96 hour LC50	8,400			
	Pimephales promelas	96 hour LC50	16,000			
	Pimephales promelas	96 hour LC50	14,000			
	Pimephales promelas	96 hour LC50	11,630			
	Pimephales promelas	96 hour LC50	14,480	11,912	11,912	3
	Poecilia reticulata	96 hour LC50	20,170	20,170	20,170	5
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	3,910			
	Daphnia magna	48 hour EC50	6,200			
	Daphnia magna	48 hour EC50	12,000			
	Daphnia magna	48 hour EC50	14,000			
	Daphnia magna	48 hour EC50	5,710			
	Daphnia magna	48 hour EC50	7,430			
	Daphnia magna	48 hour EC50	3,800			
	Daphnia magna	48 hour EC50	2,600	6,012	6,012	1
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50				
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)						
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50				
H: A family in any order of insect or any phylum not already represented		96 hour LC50				

Lowest GMAV	6,012
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	751.5
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Cyclohexane (CAS #110827)

Criteria (ug/L)	
Acute:	2,480
Chronic:	275.56

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	34,720	34,720	34,720	1	728
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Carassius auratus	96 hour LC50	42,330	42,330	42,330	3	728
	Gambusia affinis	96 hour LC50	15,500,000	15,500,000	15,500,000	7	508
	Pimephales promelas	96 hour LC50	4,530				3,217
	Pimephales promelas	96 hour LC50	117,000				719
	Pimephales promelas	96 hour LC50	32,710				728
	Pimephales promelas	96 hour LC50	42,330				728
	Pimephales promelas	96 hour LC50	93,000	36,882	36,882	2	719
	Poecilia reticulata	96 hour LC50	57,680	57,680	57,680	5	728
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	135,000	135,000	135,000	6	770
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)	Chironomidae	96 hour LC50	570,000	570,000	570,000	4	770
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented							

Lowest GMAV	34,720
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	4,960
ACR	18

Derivation of Freshwater Aquatic Life Criteria
3,3-Dichlorobenzidine (CAS #91941)

Criteria (ug/L)	
Acute:	40.38
Chronic:	4.49

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)							
	Pimephales promelas	96 hour LC50	2,080				17,138
	Pimephales promelas	96 hour LC50	1,770				17,138
	Pimephales promelas	96 hour LC50	1,050				17,138
	Pimephales promelas	96 hour LC50	1,880				17,138
	Pimephales promelas	96 hour LC50	2,770	1,823	1,823	2	17,138
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	1,050	1,050	1,050	1	17,138
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	1,050
Number of data requirements satisfied	2
Select Secondary Acute Factor	13
Secondary Acute Value	80.77
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Dichloroprop (CAS #120365)

Criteria (ug/L)	
Acute:	105.29
Chronic:	11.70

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	2,700				344
	Oncorhynchus mykiss	96 hour LC50	500				344
	Oncorhynchus mykiss	96 hour LC50	5,220				344
	Oncorhynchus mykiss	96 hour LC50	6,100	2,561	2,561	2	344
	Salmo trutta	96 hour LC50	78,000				62,367
	Salmo trutta	96 hour LC50	91,000	84,250	84,250	4	19,224
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	2,400				344
	Lepomis macrochirus	96 hour LC50	2,400				344
	Lepomis macrochirus	96 hour LC50	830	1,685	1,685	1	344
C: A third family in the phylum Chordata (e.g. fish, amphibian)		96 hour LC50					
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	100,000				344
	Daphnia magna	48 hour EC50	5,400				344
	Daphnia magna	48 hour EC50	6,250	15,000	15,000	3	344
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)							
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)							
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	1,685
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	210.58
ACR	18

Derivation of Freshwater Aquatic Life Criteria

Ethanol (CAS #64175)

Criteria (ug/L)	
Acute:	20,491.80
Chronic:	2,276.87

Data Requirements 1: Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Probability P=R/(N+1)
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	6,302,000				
	Oncorhynchus mykiss	96 hour LC50	13,000,000	9,051,298	9,051,298	3	
B: One other species, warm water, commercially/recreationally impo	Pimephales promelas	96 hour LC50	13,480,000				
			15,300,000				
- Osteichthyes (e.g.bluegill, channel catfish)	Pimephales promelas	96 hour LC50	14,200,000	14,307,263	14,307,263	5	
C: A third family in the phylum Chordata (e.g. fish, amphibian)							
		96 hour LC50					
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	9,300,000				
	Daphnia magna	48 hour EC50	10,000,000				
	Daphnia magna	48 hour EC50	11,853,000				
	Daphnia magna	48 hour EC50	14,136,000				
	Daphnia magna	48 hour EC50	10,860,000				
	Daphnia magna	48 hour EC50	5,680,000				
	Daphnia magna	48 hour EC50	13,248,000				
	Daphnia magna	48 hour EC50	9,268,000				
	Daphnia magna	48 hour EC50	14,221,000				
	Daphnia magna	48 hour EC50	13,470,000				
	Daphnia magna	48 hour EC50	11,967,000				
	Daphnia magna	48 hour EC50	9,300,000				
	Daphnia magna	48 hour EC50	12,820,000				
	Daphnia magna	48 hour EC50	9,248,000	10,811,946			
	Daphnia obtusa	48 hour EC50	10,600,000	10,600,000	10,705,448	4	
	Ceriodaphnia dubia	48 hour EC50	6,772,000				
	Ceriodaphnia dubia	48 hour EC50	6,325,000				
	Ceriodaphnia dubia	48 hour EC50	6,076,000				
	Ceriodaphnia dubia	48 hour EC50	8,808,000				
	Ceriodaphnia dubia	48 hour EC50	6,386,000				
	Ceriodaphnia dubia	48 hour EC50	3,715,000				
	Ceriodaphnia dubia	48 hour EC50	5,577,000	6,069,082	6,069,082	2	
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)	Palaemonetes kadiaker	96 hour LC50	250,000	250,000	250,000	1	
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)							
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)	Corbicula manilensis	96 hour LC50	60,000,000	60,000,000	60,000,000	6	
H: A family in any order of insect or any phylum not already represented							

Lowest GMAV	250,000
Number of data requirements satisfied	5

Derivation of Freshwater Aquatic Life Criteria

Ethyl Acetate (CAS #141786)

Criteria (ug/L)	
Acute:	14,375.00
Chronic:	1,597.22

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	425,300				12,210
	Oncorhynchus mykiss	96 hour LC50	484,000				12,210
		96 hour LC50		453,702	453,702	3	
B: One other species, warm water, commercially/recreationally important		96 hour LC50					
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	230,000	230,000	230,000	1	12,448
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia pulex	48 hour EC50	230,000				2,017
	Daphnia pulex	48 hour EC50	295,000	260,480			2,017
	Daphnia magna	48 hour EC50	660,000				2,017
	Daphnia magna	48 hour EC50	560,000				2,017
	Daphnia magna	48 hour EC50	698,000				2,017
	Daphnia magna	48 hour EC50	778,000				2,017
	Daphnia magna	48 hour EC50	786,000				2,017
	Daphnia magna	48 hour EC50	819,000	711,015	430,355	2	2,017
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	230,000
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	28,750
ACR	18

Derivation of Freshwater Aquatic Life Criteria
Formaldehyde (CAS #50000)

Criteria (ug/L)	
Acute:	4576.26
Chronic:	965.95

Data Requirements 1: Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Probability P=R/(N+1)	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	49,610					Bills, 1974
	Oncorhynchus mykiss	96 hour LC50	69,370					Bills et al, 1977
	Oncorhynchus mykiss	96 hour LC50	68,970					Bills et al, 1977
	Oncorhynchus mykiss	96 hour LC50	68,970					Bills et al, 1977
	Oncorhynchus mykiss	96 hour LC50	48,800					15908
	Oncorhynchus mykiss	96 hour LC50	49,210					15908
	Oncorhynchus mykiss	96 hour LC50	58,480					Bills, 1974
	Oncorhynchus mykiss	96 hour LC50	54,050					Bills, 1974
	Oncorhynchus mykiss	96 hour LC50	69,370					Bills et al, 1977
	Oncorhynchus mykiss	96 hour LC50	60,100					Bills et al, 1981
	Oncorhynchus mykiss	96 hour LC50	48,800					15908
	Oncorhynchus mykiss	96 hour LC50	47,590					Bills et al, 1977
	Oncorhynchus mykiss	96 hour LC50	98,820	59,568	59,568	17		Bills et al, 1977
	Salvelinus namaysusis	96 hour LC50	40,330	40,330	40,330	12		Bills et al, 1977
	Salmo salar	96 hour LC50	69,780	69,780	69,780	19		Bills et al, 1977
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis machrochirus	96 hour LC50	29,640					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	34,770					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	47,190					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	42,750					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	35,650					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	36,700					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	40,330					Bills et al, 1977
	Lepomis machrochirus	96 hour LC50	50,420	39,161				Bills et al, 1977
	Lepomis cyanellus	96 hour LC50	69,780	69,780	52,275	15		Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	26,420					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	26,540					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	22,790					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	25,010					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	24,970					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	19,760					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	28,190					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	25,810					Bills et al, 1977
	Ictalurus punctulatus	96 hour LC50	27,830					2969
	Ictalurus punctulatus	96 hour LC50	21,780					15908
	Ictalurus punctulatus	96 hour LC50	14,120					15908
	Ictalurus punctulatus	96 hour LC50	14,280					15908
	Ictalurus punctulatus	96 hour LC50	19,040	22,283	22,283	7		15908
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Morone saxitella	96 hour LC50	10,000					Hughes,1975
	Morone saxitella	96 hour LC50	20,740					Bills et al, 1993
	Morone saxitella	96 hour LC50	17,780					Bills et al, 1993
	Morone saxitella	96 hour LC50	15,930					Bills et al, 1993
	Morone saxitella	96 hour LC50	19,260					Bills et al, 1993
	Morone saxitella	96 hour LC50	23,700					Bills et al, 1993
	Morone saxitella	96 hour LC50	19,630					Bills et al, 1993
	Morone saxitella	96 hour LC50	21,850					Bills et al, 1993
	Morone saxitella	96 hour LC50	24,400					Bills et al, 1993
	Morone saxitella	96 hour LC50	15,000					Hughes,1975
	Morone saxitella	96 hour LC50	7,260					909
	Morone saxitella	96 hour LC50	11,110					Bills et al, 1993
	Morone saxitella	96 hour LC50	27,780	16,936	16,936	4	0.1739	Bills et al, 1993
	Anguilla rostra	96 hour LC50	31,100	31,100	31,100	10		593
	Amereius melas	96 hour LC50	25,050	25,050	25,050	8		Bills et al, 1977
	Micropterus dolomieu	96 hour LC50	54,850	54,850				Bills et al, 1977
	Micropterus salmoides	96 hour LC50	57,680	57,680	56,247	16		Bills et al, 1977
	Pimephales promelas	96 hour LC50	24,100					NEB, 1998b
	Pimephales promelas	96 hour LC50	27,200	25,603	25,603	9		3217
	Rana pipens	72 hour LC50	8,700	8,700				Helms, 1967
	Rana catesbeiana	72hour LC50	9,520	9,520	9,101	1	0.0435	Helms, 1967
	Bufo sp.	96 hour LC50	18,600	18,600	18,600	5		Helms, 1967
	Daphnia magna	48 hour EC50	7,600					Nazarenko,1970
	Daphnia magna	48 hour EC50	29,000					Janssen Persoone,1993
	Daphnia magna	48 hour EC50	20,000	16,396				Prasad,1980

Derivation of Freshwater Aquatic Life Criteria

Formaldehyde (CAS #50000) **Date 1/20/2015**

D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia pulex	48 hour EC50	5,800					18459
	Daphnia pulex	48 hour EC50	14,750					NEB,1998a
	Daphnia pulex	48 hour EC50	12,200	10,144	12,896	3	0.1304	NEB.1998b
	Ceriodaphnia dubia	48 hour EC50	11,930					Vasu,1990
	Ceriodaphnia dubia	48 hour EC50	11,410					Vasu,1990
	Ceriodaphnia dubia	48 hour EC50	12,870					Vasu,1990
	Ceriodaphnia dubia	48 hour EC50	9,450					NEB,1998a
	Ceriodaphnia dubia	48 hour EC50	9,600	10,971	10,971	2	0.0870	NEB,1998b
	Bosmina sp.	48 hour EC50	20,000	20,000	20,000	6		Prasad,1980
	Cyclops sp	48 hour EC50	20,000	20,000	20,000	6		Prasad,1980

E: A benthic crustacean (e.g. ostracod, isopod, amphipod)								
	Cypridopsis vidua	96 hour LC50	54,400					NEB,1998b
	Cypridopsis vidua	96 hour LC50	34,400					NEB,1998b
	Cypridopsis vidua	96 hour LC50	68,200	50,348	50,348	14		NEB,1998a
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)	Notonecta sp	96 hour LC50	336,780	336,780	336,780	20		Bills et al, 1977
	Chironomous sp	96 hour LC50	450,000	450,000	450,000	21		Prasad,1980
G: A faimly in a phylum other than Arthropoda or Chorda	Corbicula sp.	96 hour LC50	46,670					418
(e.g. Rotifera, Annelida, Mollusca)	Corbicula sp.	96 hour LC50	35,190					418
	Corbicula sp.	96 hour LC50	50,820	43,702	43,702	13		Bills et al, 1977
	Helisoma sp.	96 hour LC50	37,800	37,800	37,800	11		Bills et al, 1977
H: A family in any order of insect or any phylum not already represented	Palemonecteskadiakensis	96 hour LC50	187,550	187,550	187,550	19		Bills et al, 1977

Derivation of Freshwater Aquatic Life Criteria
Hexachlorocyclopentadiene (CAS #77474)

Criteria (ug/L)	
Acute:	0.61
Chronic:	0.07

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important	Ictalurus punctatus	96 hour LC50	97		97	3	17,136
- Osteichthyes (e.g.bluegill, channel catfish)	Micropterus salmoides	96 hour LC50	20,000		20,000	5	2,786
	Lepomis macrochirus	96 hour LC50	130		130	4	17,136
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	13.9				14,339
	Pimephales promelas	96 hour LC50	7	9.86	9.86	1	2,097
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	39				17,136
	Daphnia magna	48 hour EC50	52.2	45.12	45.12	2	58,785
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	9.86
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	5.63
ACR	18

Derivation of Freshwater Aquatic Life Criteria
Isopropylbenzene (CAS #98828)

Criteria (ug/L)	
Acute:	192.86
Chronic:	21.43

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	2,700	2,700	2,700	1
B: One other species, warm water, commercially/recreationally important	Pimephales promelas	96 hour LC50	6,320	6,320	6,320	3
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50				
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Poecilia reticulata	96 hour LC50	5,100	5,100	5,100	2
		96 hour LC50				
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	10,600			
	Daphnia magna	48 hour EC50	10,600			
	Daphnia magna	48 hour EC50	11,200			
	Daphnia magna	48 hour EC50	10,600			
	Daphnia magna	48 hour LC50	20,300			
	Daphnia magna	48 hour LC50	34,300			
	Daphnia magna	48 hour LC50	30,500			
	Daphnia magna	48 hour LC50	20,300	20,300	20,300	4
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50				
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50				
G: A family in a phylum other than Arthropoda or Chordata		96 hour LC50				
(e.g. Rotifera, Annelida, Mollusca)						
H: A family in any order of insect or any phylum not already represented		96 hour LC50				

Lowest GMAV	2,700
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	385.71
ACR	18

Derivation of Freshwater Aquatic Life Criteria
4-Isopropyltoluene (CAS #99876)

Criteria (ug/L)	
Acute:	183.42
Chronic:	20.38

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV
A: The family Salmonidae in the class Osteichthyes		96 hour LC50				
B: One other species, warm water, commercially/recreationally important	Lepomis micropterus	96 hour LC50	44,000	44,000	44,000	2
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50				
C: A third family in the phylum Chordata (e.g. fish, amphibian)		96 hour LC50				
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour LC50	6,500			
	Daphnia magna	48 hour EC50	3,500	4,770		1
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50				
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50				
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50				
H: A family in any order of insect or any phylum not already represented		96 hour LC50				

Lowest GMAV	4,769
Number of data requirements satisfied	2
Select Secondary Acute Factor	13
Secondary Acute Value	367
ACR	18

Derivation of Freshwater Aquatic Life Criteria
3-Methyl-4-Chlorophenol (CAS #59507)

Criteria (ug/L)	
Acute:	65.50
Chronic:	7.28

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	917	917	917	1
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Pimephales promelas	96 hour LC50	4,050			
	Pimephales promelas	96 hour LC50	4,050			
	Pimephales promelas	96 hour LC50	7,380			
	Pimephales promelas	96 hour LC50	7,560	5,500	5,500	3
	Poecilia reticulata	96 hour LC50	6,710	6,710	6,710	4
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	2,300			
	Daphnia magna	48 hour EC50	1,500			
	Daphnia magna	48 hour EC50	2,000	1,904	1,904	2
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50				
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)						
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)	Lymnaea stagnalis	96 hour LC50	14,000		14,000	5
H: A family in any order of insect or any phylum not already represented		96 hour LC50				

Lowest GMAV	917
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	131
ACR	18

Derivation of Freshwater Aquatic Life Criteria

2-Methyl-4,6-Dinitrophenol (CAS #534521)

Criteria (ug/L)	
Acute:	6.35
Chronic:	0.71

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	66	66	66	1	6,797
B: One other species, warm water, commercially/recreationally important		96 hour LC50					
- Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	360	360	360	3	6,797
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Leuciscus idus	96 hour LC50	1,500	1,500	1,500	4	56,301
	Pimephales promelas	96 hour LC50	1,540				12,447
	Pimephales promelas	96 hour LC50	1,540				12,447
	Pimephales promelas	96 hour LC50	2,720				15,031
	Pimephales promelas	96 hour LC50	2,200				2,189
	Pimephales promelas	96 hour LC50	1,900	1,933	1,933	7	2,189
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia pulex	48 hour EC50	145	145			6,797
	Daphnia magna	48 hour EC50	2,700				846
	Daphnia magna	48 hour EC50	3,100				5,184
	Daphnia magna	48 hour EC50	3,300	3,023	662.05	5	5,675
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)	Gammarus fasciatus	48 hour EC50	1,100	1,100		6	6,797
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)	Pteronarcys californicus	96 hour LC50	320	320		2	6,797
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	66
Number of data requirements satisfied	6
Select Secondary Acute Factor	5.2
Secondary Acute Value	12.69
ACR	18

Derivation of Freshwater Aquatic Life Criteria

4-Methylphenol (CAS #106445)

Criteria (ug/L)	
Acute:	499.20
Chronic:	55.47

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	8,600	7,987	7,987	1	59,196
		96 hour LC50	7,500				10,688
		96 hour LC50	7,900				569
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Pimephales promelas	96 hour LC50	19,000	22,503	22,503	3	719
	Pimephales promelas	96 hour LC50	16,500				12,858
	Pimephales promelas	96 hour LC50	28,600				59,196
	Pimephales promelas	96 hour LC50	28,600				569
C: A third family in the phylum Chordata (e.g. fish, amphibian)		96 hour LC50					
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	7,700	10,025	12,662	2	846
	Daphnia magna	48 hour EC50	21,100				7,458
	Daphnia magna	48 hour EC50	21,100				15,251
	Daphnia magna	48 hour EC50	21,100				2,120
	Daphnia magna	48 hour EC50	1,400				553
	Daphnia pulex	48 hour EC50	22,700	22,700			59,196
	Daphnia pulicaria	48 hour EC50	22,700	22,700			569
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	7,987
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	998.40
ACR	18

Derivation of Freshwater Aquatic Life Criteria
2-Nitroaniline (CAS #88744)

Criteria (ug/L)	
Acute:	188.08
Chronic:	20.90

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important		96 hour LC50					
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Danio rerio[1]	96 hour LC50	19,472	19,472	19,472	2	5,436
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	4,890	4,890	4,890	1	55,962
		48 hour EC50					
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	4,890
Number of data requirements satisfied	2
Select Secondary Acute Factor	13
Secondary Acute Value	376.15
ACR	18

Derivation of Freshwater Aquatic Life Criteria
3-Nitroaniline (CAS #199092)

Criteria (ug/L)	
Acute:	61.25
Chronic:	6.81

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Poecilia reticulata	96 hour LC50	81,200	81,200	81,200	2	19,263
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	980	980	980	1	19,263
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)	Lymnaea stagnalis	96 hour LC50	143,000	143,000	143,000	3	19,263
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	980
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	122.5
ACR	18

Derivation of Freshwater Aquatic Life Criteria

4-Nitroaniline (CAS #100016)

Criteria (ug/L)	
Acute:	1,062.50
Chronic:	118.06

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Pimephales promelas	96 hour LC50	106,100	113,978	113,978	3	2,965
	Pimephales promelas	96 hour LC50	101,800				2,966
	Pimephales promelas	96 hour LC50	125,000				15,031
	Pimephales promelas	96 hour LC50	125,000				3,217
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Danio rerio[1]	96 hour LC50	87,600	104,807	104,807	2	11,037
			125,395				5,436
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	17,000	17,000	17,000	1	55,961
		48 hour EC50					
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	17,000
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	2,125
ACR	18

Derivation of Freshwater Aquatic Life Criteria
Pentachloronitrobenzene (CAS #82688)

Criteria (ug/L)	
Acute:	22.17
Chronic:	2.46

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	310	543.56	543.56	2	344
	Oncorhynchus mykiss	96 hour LC50	550				344
	Oncorhynchus mykiss	96 hour LC50	1,600				344
	Oncorhynchus mykiss	96 hour LC50	320				344
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	750	354.76	354.76	1	344
	Lepomis macrochirus	96 hour LC50	240				344
	Lepomis macrochirus	96 hour LC50	100				344
	Lepomis macrochirus	96 hour LC50	880				344
C: A third family in the phylum Chordata (e.g. fish, amphibian)		96 hour LC50					
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	770	770	770	3	344
		48 hour EC50					
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	354.76
Number of data requirements satisfied	3
Select Secondary Acute Factor	8
Secondary Acute Value	44.35
ACR	18

Derivation of Freshwater Aquatic Life Criteria
Pyridine (CAS #110861)

Criteria (ug/L)	
Acute:	235.97
Chronic:	26.22

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhychus gorbuscha	96 hour LC50	1,100	1,100			12,605
	Oncorhychus keta	96 hour LC50	3,700	3,700			12,605
	Oncorhychus mykiss	96 hour LC50	4,600	4,600			12,605
	Oncorhychus tshawytsha	96 hour LC50	2,900	2,900			12,605
	Oncorhychus nerka	96 hour LC50	6,300	6,300			12,605
	Oncorhychus kisutch	96 hour LC50	3,800	3,800	3,304	1	12,605
B: One other species, warm water, commercially/recreationally important	Pimephales promelas	96 hour LC50	106,000				12,858
- Osteichthyes (e.g.bluegill, channel catfish)	Pimephales promelas	96 hour LC50	93,800	99,714	99,714	3	12,858
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Xenopus laevis	96 hour LC50	1,090,000				6,325
	Xenopus laevis	96 hour LC50	2,460,000				6,325
	Xenopus laevis	96 hour LC50	1,620,000				6,325
	Xenopus laevis	96 hour LC50	1,050,000	1,461,391	1,461,391	7	6,325
	Danio rerio[1]	96 hour LC50	512,000	512,000	512,000	4	11,037
	Cyprinus carpio	96 hour LC50	26,000	26,000	26,000	2	2,077
	Leusiscus idus	96 hour LC50	512,000	512,000	512,000	4	11,037
	Gambusia affinis	96 hour LC50	1,300,000	1,300,000	1,300,000	6	508
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	1,140,000				2,017
	Daphnia magna	48 hour EC50	1,210,000				2,017
	Daphnia magna	48 hour EC50	1,940,000				2,017
	Daphnia magna	48 hour EC50	1,120,000				2,017
	Daphnia magna	48 hour EC50	944,000				915
	Daphnia magna	48 hour EC50	1,570,000	1,282,125			2,017
	Daphnia pulex	48 hour EC50	630,000				2,017
	Daphnia pulex	48 hour EC50	520,000		1,048,011	5	2,017
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	3,304
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	471.93
ACR	18

Derivation of Freshwater Aquatic Life Criteria
Tert-butyl alcohol (CAS #75650)

2-Methyl-2-propanol	
Criteria (ug/L)	
Acute:	211,692.31
Chronic:	23,521.37

Data Requirements 1: Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes		96 hour LC50					
B: One other species, warm water, commercially/recreationally important		96 hour LC50					
- Osteichthyes (e.g.bluegill, channel catfish)		96 hour LC50					
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	6,410,000	6,410,000	6,410,000	2	12,858
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	5,504,000	5,504,000	5,504,000	1	846
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata		96 hour LC50					
(e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	5,504,000
Number of data requirements satisfied	2
Select Secondary Acute Factor	13
Secondary Acute Value	423,385
ACR	18

Derivation of Freshwater Aquatic Life Criteria

1,2,4,5-Tetrachlorobenzene (CAS #95943)

Criteria (ug/L)	
Acute:	18.18
Chronic:	2.02

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	10,000				11,519
	Oncorhynchus mykiss	96 hour LC50	10,000				11,519
	Oncorhynchus mykiss	96 hour LC50	10,000				11,519
	Oncorhynchus mykiss	96 hour LC50	1,200				11,519
	Oncorhynchus mykiss	96 hour LC50	10,000	6,544	6,544	4	11,519
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	1,600	1,600	1,600	2	5,590
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	460				17,138
	Pimephales promelas	96 hour LC50	320				17,138
	Pimephales promelas	96 hour LC50	89				17,138
	Pimephales promelas	96 hour LC50	320	254.46	254.46	1	17,138
	Jordanella floridae	96 hour LC50	2,080				140
	Jordanella floridae	96 hour LC50	2,150	2,115	2,115	3	140
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour LC50 48 hour EC50	530,000	530,000	530,000	5	5,184
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)							
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	254.46
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	36.35
ACR	18

Derivation of Freshwater Aquatic Life Criteria

2,4,5-Trichlorophenol (CAS #95954)

Criteria (ug/L)	
Acute:	24.76
Chronic:	2.75

Data Requirements Data from 8 Different Families including:	Organism	Test Type	Result	SMAV	GMAV	Rank GMAV	Reference
A: The family Salmonidae in the class Osteichthyes	Oncorhynchus mykiss	96 hour LC50	460				13,037
	Oncorhynchus mykiss	96 hour LC50	460				13,042
	Oncorhynchus mykiss	96 hour LC50	249				56,474
	Oncorhynchus mykiss	96 hour LC50	274	346.63	346.63	1	56,474
B: One other species, warm water, commercially/recreationally important - Osteichthyes (e.g.bluegill, channel catfish)	Lepomis macrochirus	96 hour LC50	600				13,042
	Lepomis macrochirus	96 hour LC50	450				5,590
	Lepomis macrochirus	96 hour LC50	600	545.14	545.14	2	13,037
C: A third family in the phylum Chordata (e.g. fish, amphibian)	Pimephales promelas	96 hour LC50	902				5,313
	Pimephales promelas	96 hour LC50	1,268	1,069	1,069	3	56,474
	Poecilia reticulata	96 hour LC50	1,200	1,200	1,200	4	45,297
D: A planktonic crustacean (e.g. cladoceran, copepod)	Daphnia magna	48 hour EC50	900				846
	Daphnia magna	48 hour LC50	2,700	1,559	1,559	5	5,184
	Ceriodaphnia dubia	48 hour LC50	1,742	1,742	1,742	6	56,474
E: A benthic crustacean (e.g. ostracod, isopod, amphipod)		96 hour LC50					
F: An insect (e.g. may-, dragon-, damsel-, stone-, caddisfly, mosquito, midge)		96 hour LC50					
G: A family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca)		96 hour LC50					
H: A family in any order of insect or any phylum not already represented		96 hour LC50					

Lowest GMAV	346.63
Number of data requirements satisfied	4
Select Secondary Acute Factor	7
Secondary Acute Value	49.52
ACR	18

Tables

Table 1: Toxicity Values						
Substance	**Recommended Oral Toxicity Value**	**Type of Oral Toxicity Value[1]**	**Source of Oral Toxicity Value[2]**	**Recommended Inhalation Toxicity Value**	**Type of Inhalation Toxicity Value[1]**	**Source of Inhalation Toxicity Value[2]**
Acenaphthene	0.06	RfD oral	IRIS	0.025	RfC	CTDEEP
Acenaphthylene	0.06	RfD oral	IRIS	0.025	RfC	CTDEEP
Anthracene	0.3	RfD oral	IRIS	0.025	RFC	IRIS
Benzo(a) anthracene	0.1	CSF oral	Cal OEHHA	0.00006	Unit Risk	Cal-OEHHA
Benzo(a) pyrene	1	CSF oral	IRIS	0.0006	Unit Risk	IRIS
Benzo(b)fluoranthene	0.1	CSF oral	CalOEHHA	0.00006	Unit Risk	Cal-OEHHA
Benzo(e)pyrene	0.003	RfD oral	IRIS w/ modification	0.025	RfC	CTDEEP
Benzo(k)fluoranthene	0.1	CSF oral	CalOEHHA	0.00006	Unit Risk	Cal-OEHHA
Bis(2-chloroethyl)ether	1.1	CSF oral	IRIS	0.00033	Unit Risk	IRIS
Bis(2-chloroisopropyl)ether	0.004	RfD oral	IRIS w/ modification	0.014	RfC	IRIS w/mod
Bis(2-ethylhexyl)phthlate	0.14	CSF oral	IRIS	0.000002	Unit Risk	IRIS
Bromoform	0.0079	CSF oral	IRIS	0.0000011	Unit Risk	IRIS
Butyl benzyl phthlate	0.0019	CSF oral	IRIS	0.0000005	Unit Risk	IRIS
Chlorophenol-2	0.005	RfD oral	IRIS	0.018	RfC	IRIS
Dibenz(a,h) anthracene	1	CSF oral	CalOEHHA	0.0006	Unit Risk	Cal-OEHHA
Dibromochloromethane	0.084	CSF oral	IRIS	0.000024	Unit Risk	IRIS
Dichlorophenol, 2,4-	0.003	RfD oral	IRIS	0.01	RfC	IRIS
Di-n-butyl phthlate	0.0015	RfD oral	CalOEHHA	0.005	RFC	Cal-OEHHA
Di-n-octyl phthlate	0.01	RfD oral	USEPA PPRTV	0.035	RFC	USEPA PPRTV
Fluoranthene	0.04	RfD oral	ATSDR w/Modification	0.025	RfC	CTDEEP

Table 1: Toxicity Values						
Substance	**Recommended Oral Toxicity Value**	**Type of Oral Toxicity Value[1]**	**Source of Oral Toxicity Value[2]**	**Recommended Inhalation Toxicity Value**	**Type of Inhalation Toxicity Value[1]**	**Source of Inhalation Toxicity Value[2]**
Fluornene	0.04	RfD oral	IRIS	0.025	RFC	CTDEEP
Hexachlorobenzene	1.6	CSF oral	IRIS	0.00046	Unit Risk	IRIS
Hexachloroethane	0.04	CSF oral	IRIS	0.000011	Unit Risk	IRIS
Naphthalene	0.02	RfD oral	IRIS	0.00034	Unit Risk	Cal-OEHHA
Pentachlorophenol	0.4	CSF Oral	IRIS	0.0001100	Unit Risk	Cal-OEHHA
Per- and Polyfluoroalkyl Substances (PFAS)[4]	0.00002	RfD oral	DPH Risk Assessment			
Perylene	0.003	RfD oral	IRIS w/ Modification	0.025	RFC	CTDEEP
Phenanthrene	0.03	RfD oral	MassDEP	0.025	RfC	CTDEEP
Phenol	0.03	RfD oral	IRIS w/ Modification	0,1	RfC	IRIS w/mod
Pyrene	0.06	RfD oral	IRIS	0.025	RfC	CTDEEP

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

RfC:
These values are Reference Doses (mg/m^3) for inhalation exposures to non-carcinogenic substances

Unit Risk:
These values are for inhalation exposures to carcinogenic substances ($1/ug/m^3$)

2 Sources:
IRIS: USEPA Integrated Risk Information System
http://www2.epa.gov/iris

Table 1: Toxicity Values						
Substance	**Recommended Oral Toxicity Value**	**Type of Oral Toxicity Value[1]**	**Source of Oral Toxicity Value[2]**	**Recommended Inhalation Toxicity Value**	**Type of Inhalation Toxicity Value[1]**	**Source of Inhalation Toxicity Value[2]**
		USEPA PPRTV: EPA Provisional Peer Reviewed Toxicity Values for Superfund http://hhpprtv.ornl.gov/ EPA WQC 2015: EPA National Recommended Water Quality Criteria http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#hhtable CAL-OEHHA: California Office of Environmental Health Hazard Assessment http://oehha.ca.gov/tcdb/index.asp ATSDR: Agency for Toxic Substances and Disease Registry Minimum Risk Levels http://www.atsdr.cdc.gov/mrls/index.asp HEAST: EPA Health Effects Assessment Summary Tables for Superfund http://epa-heast.ornl.gov/				
	3	Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).				
	4	PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA) Source: DPH "Drinking Water Action Level for Perfluorinated Alkyl Substances (PFAS)", 12/12/16 https://portal.ct.gov/DPH/Environmental-Health/Environmental-and-Occupational-Health-Assessment/Toxicology-and-Risk-Assessment				

Table 2: Residential Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended Residential Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
83329	Acenaphthene	Semivolatile Organic Substance	0.06	RfD oral	4,064.52	1000	0.2	**1,000**	**Ceiling Value**
75058	Acetonitrile	Volatile Organic Substance	0.005	RfD oral	338.71	500	0.005	**340**	**Risk-based**
107028	Acrolein	Volatile Organic Substance	0.0005	RfD oral	33.87	500	0.01	**34**	**Risk-based**
309002	Aldrin	Pesticide	17	CSF oral	0.04	500	0.002	**0.04**	**Risk-based**
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance						**500**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance						**500**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C9-C18	Volatile Organic Substance						**500**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C19-C36	Semivolatile Organic Substance						**1,000**	**DEEP 2012**[2]
7429905	Aluminum	Inorganic Substance	1	RfD oral	67,741.94	50000	20	**50,000**	**Ceiling Value**
7664417	Ammonia	Inorganic Substance	0.1	RfD oral	6,774.19	50000		**6,800**	**Risk-based**
62533	Aniline	Semivolatile Organic Substance	0.0057	CSF oral	107.46	1000	0.2	**110**	**Risk-based**
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance						**500**	**DEEP 2012**
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance						**1,000**	**DEEP 2012**
92875	Benzidine	Semivolatile Organic Substance	230	CSF oral	0.003	1000	0.2	**0.20**	**Analytical Adjustment**
191242	Benzo(g,h,i)perylene	Semivolatile Organic Substance	0.073	CSF oral	8.39	1000	0.2	**8.4**	**Risk-based**
65850	Benzoic Acid	Semivolatile Organic Substance	4	RfD oral	270,967.74	1000	0.2	**1,000**	**Ceiling Value**
111911	Bis(2-chloroethoxy)methane	Semivolatile Organic Substance	0.003	RfD oral	203.23	1000	0.2	**200**	**Risk-based**
7440428	Boron	Inorganic Substance	0.2	RfD oral	13,548.39	50000	5	**13,500**	**Risk-based**
75274	Bromodichloromethane	Volatile Organic Substance	0.034	CSF oral	18.01	500	0.005	**18**	**Risk-based**
74839	Bromomethane	Volatile Organic Substance	0.0005	RfD oral	33.87	500	0.005	**34**	**Risk-based**
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD oral	3,387.10	500	0.005	**500**	**Ceiling Value**

Table 2: Residential Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended Residential Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD oral	3,387.10	500	0.005	**500**	**Ceiling Value**
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD oral	3,387.10	500	0.005	**500**	**Ceiling Value**
86748	Carbazole	Semivolatile Organic Substance	0.02	CSF oral	30.63	1000	0.2	**31**	**Risk-based**
75150	Carbon disulfide	Volatile Organic Substance	0.1	RfD oral	6,774.19	500	0.005	**500**	**Ceiling Value**
57749	Chlordane (Total)[3]	Pesticide						**0.49**	**1996 RSR**
7782505	Chlorine	Inorganic Substance	0.1	RfD oral	6,774.19	50000		**6,800**	**Risk-based**
106478	Chloroaniline, 4-	Semivolatile Organic Substance	0.2	CSF oral	3.06	1000	0.2	**3.1**	**Risk-based**
75003	Chloroethane	Volatile Organic Substance	0.0047	CSF Oral	130.32	500	0.005	**130**	**Risk-based**
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD oral	176.13	500	0.05	**180**	**Risk-based**
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD oral	5,419.35	500	0.2	**500**	**Ceiling Value**
59507	Chlorophenol, 3-methyl-4	Semivolatile Organic Substance	0.1	RfD oral	6,774.19	1000	0.2	**1,000**	**Ceiling Value**
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.02	RfD oral	1,354.84	500	0.2	**500**	**Ceiling Value**
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.02	RfD oral	1,354.84	500	0.2	**500**	**Ceiling Value**
218019	Chrysene	Semivolatile Organic Substance	0.0073	CSF oral	83.90	1000	0.2	**84**	**Risk-based**
7440484	Cobalt	Inorganic Substance	0.0003	RfD oral	20.32	50000	2	**20**	**Risk-based**
110827	Cyclohexane	Volatile Organic Substance	1.7	RfD oral	115,161.29	500	0.005	**500**	**Ceiling Value**
72548	Dibenzo(a,h)anthracene	Semivolatile Organic Substance	7.3	CSF oral	0.08	1000	0.2	**1.0**	**Based on 1996 RSR PAH Values**
72559	Dibenzofuran	Volatile Organic Substance	0.001	RfD oral	67.74	500	0.2	**68**	**Risk-based**
50293	Dibromo-3-chloropropane, 1,2-	Semivolatile Organic Substance	7	CSF oral	0.09	1000	0.005	**0.09**	**Risk-based**
53703	Dicamba	Pesticide	0.03	RfD oral	2,032.26	500	0.001	**500**	**Ceiling Value**
132649	Dichlorobenzidine, 3,3'-	Semivolatile Organic Substance	0.45	CSF oral	1.36	1000	0.2	**1.4**	**Risk-based**

Table 2: Residential Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended Residential Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
1918009	Dichlorodiflouromethane	Volatile Organic Substance	0.05	RfD oral	3,387.10	500	0.005	**500**	**Ceiling Value**
75718	Dichlorodiphenyl Trichloroethane, P, P'- (DDT) (Total) [4]	Pesticide	0.34	CSF oral	1.80	500	0.003	**1.8**	**Risk-based**
120365	Dichloroprop	Pesticide	0.0036	RfD oral	243.87	500	0.005	**240**	**Risk-based**
84662	Diethyl phthalate	Semivolatile Organic Substance	0.8	RfD oral	54,193.55	1000	0.2	**1,000**	**Ceiling Value**
131113	Dimethyl phthalate	Semivolatile Organic Substance	10	RfD oral	677,419.35	1000	0.2	**1,000**	**Ceiling Value**
105679	Dimethylphenol, 2,4-	Semivolatile Organic Substance	0.02	RfD oral	1,354.84	1000	0.2	**1,000**	**Ceiling Value**
51285	Dinitrophenol, 2,4-	Semivolatile Organic Substance	0.002	RfD oral	135.48	1000	0.3	**140**	**Risk-based**
534521	Dinitrophenol, 2-methyl-4,6-	Semivolatile Organic Substance	0.0003	RfD oral	20.32	1000	0.3	**20**	**Risk-based**
121142	Dinitrotoluene, 2,4-	Semivolatile Organic Substance	0.68	CSF oral	0.90	1000	0.2	**0.90**	**Risk-based**
606202	Dinitrotoluene, 2,6-	Semivolatile Organic Substance	0.68	CSF oral	0.90	1000	0.2	**0.90**	**Risk-based**
123911	Dioxane, 1,4-	Semivolatile Organic Substance	0.1	CSF oral	6.13	1000	0.1	**6.1**	**Risk-based**
122667	Diphenylhydrazine, 1,2-	Semivolatile Organic Substance	0.8	CSF oral	0.77	1000	0.2	**0.77**	**Risk-based**
115297	Endosulfan (Total) [5]	Pesticide	0.0006	RfD oral	40.65	500	0.003	**41**	**Risk-based**
72208	Endrin(Total)[6]	Pesticide				500	0.003	**20**	**1996 RSR**
64175	Ethanol	Semivolatile Organic Substance	0.067	RfD oral	4,538.71	1000		**1,000**	**Ceiling Value**
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD oral	60,967.74	500	0.005	**500**	**Ceiling Value**
107211	Ethylene glycol	Semivolatile Organic Substance	0.8	RfD oral	54,193.55	1000		**1,000**	**Ceiling Value**
50000	Formaldehyde	Semivolatile Organic Substance	0.02	RfD oral	1,354.84	1000		**1,000**	**Ceiling Value**
87683	Hexachlorobutadiene	Semivolatile Organic Substance	0.0047	CSF oral	130.32	1000	0.2	**130**	**Risk-based**
319846	Hexachlorocyclohexane, alpha	Pesticide	1.8	CSF oral	0.34	500	0.002	**0.34**	**Risk-based**
319857	Hexachlorocyclohexane, beta-	Pesticide	1.8	CSF oral	0.34	500	0.002	**0.34**	**Risk-based**

Table 2: Residential Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended Residential Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
319868	Hexachlorocyclohexane, delta-	Pesticide	1.8	CSF oral	0.34	500	0.002	**0.34**	**Risk-based**
77474	Hexachlorocyclopentadiene	Pesticide	0.006	RfD oral	406.45	500	0.2	**410**	**Risk-based**
110543	Hexane, n-	Volatile Organic Substance	0.06	RfD oral	4,064.52	500	0.005	**500**	**Ceiling Value**
591786	Hexanone-2	Volatile Organic Substance	0.005	RfD oral	338.71	500	0.2	**340**	**Risk-based**
193395	Indeno(1,2,3-c,d)pyrene	Semivolatile Organic Substance	0.73	CSF oral	0.84	1000	0.2	**1.0**	**Based on 1996 RSR PAH Values**
78591	Isophorone	Semivolatile Organic Substance	0.00095	CSF oral	644.74	1000	0.2	**640**	**Analytical Adjustment**
67630	Isopropanol	Semivolatile Organic Substance	0.33	RfD oral	22,354.84	1000	0.01	**1,000**	**Ceiling Value**
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD oral	6,774.19	500	0.005	**500**	**Ceiling Value**
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.03	RfD oral	2,032.26	500	0.005	**500**	**Ceiling Value**
7439932	Lithium	Inorganic Substance	0.002	RfD oral	135.48	50000	5	**140**	**Risk-based**
7439965	Manganese	Inorganic Substance	0.05	RfD oral	3,387.10	50000	1.5	**3,400**	**Risk-based**
67561	Methanol	Semivolatile Organic Substance	2	RfD oral	135,483.87	1000		**1,000**	**Ceiling Value**
80626	Methyl methacrylate	Volatile Organic Substance	0.14	RfD oral	9,483.87	500	0.005	**500**	**Ceiling Value**
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF oral	21.12	500	0.2	**21**	**Risk-based**
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD oral	270.97	500	0.2	**270**	**Risk-based**
95487	Methylphenol, 2- (Cresol, o-)	Semivolatile Organic Substance	0.02	RfD oral	1,354.84	1000	0.2	**1,000**	**Ceiling Value**
108394	Methylphenol, 3- (Cresol, m-)	Semivolatile Organic Substance	0.017	RfD oral	1,151.61	1000	0.2	**1,000**	**Ceiling Value**
106445	Methylphenol, 4- (Cresol, p-)	Semivolatile Organic Substance	0.02	RfD oral	1,354.84	1000	0.2	**1,000**	**Ceiling Value**
88744	Nitroaniline, 2-	Semivolatile Organic Substance	0.02	CSF oral	30.63	1000	0.3	**31**	**Risk-based**
99092	Nitroaniline, 3-	Semivolatile Organic Substance	0.02	CSF oral	30.63	1000	0.3	**31**	**Risk-based**
100016	Nitroaniline, 4-	Semivolatile Organic Substance	0.02	CSF oral	30.63	1000	0.3	**31**	**Risk-based**

Table 2: Residential Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended Residential Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
98953	Nitrobenzene	Volatile Organic Substance	0.14	CSF oral	4.38	500	0.2	**4**	**Risk-based**
62759	Nitrosodimethylamine, N-	Semivolatile Organic Substance	16	CSF oral	0.04	1000	0.2	**0.20**	**Analytical Adjustment**
621647	NitrosoDi-n-propylamine, N-	Semivolatile Organic Substance	7	CSF oral	0.09	1000	0.2	**0.20**	**Analytical Adjustment**
86306	Nitrosodiphenylamine, N-	Semivolatile Organic Substance	0.0049	CSF oral	125.00	1000	0.2	**130**	**Risk-based**
82688	Pentachloronitrobenzene	Semivolatile Organic Substance	0.001	RfD oral	67.74	1000	0.005	**68**	**Risk-based**
Various	Per- and Polyfluoroalkyl Substances (PFAS)[8]	Semivolatile Organic Substance	0.00002	RfD oral	1.35	1000	0.001	**1.35**	**Risk-based**
103651	Propylbenzene, n-	Volatile Organic Substance	0.1	RfD oral	6,774.19	500	0.005	**500**	**Ceiling Value**
57556	Propylene glycol	Semivolatile Organic Substance	20	RfD oral	1,354,838.70	1000		**1,000**	**Ceiling Value**
110861	Pyridine	Volatile Organic Substance	0.0003	RfD oral	20.32	500	0.2	**20**	**Risk-based**
75650	Tert-butyl alcohol (Total Oxygenates)	Semivolatile Organic Substance	0.017	RfD oral	1,151.61	1000	0.025	**1,000**	**Ceiling Value**
95943	Tetrachlorobenzene, 1,2,4,5-	Semivolatile Organic Substance	0.0003	RfD oral	20.32	1000	0.01	**20**	**Risk-based**
109999	Tetrahydrofuran	Volatile Organic Substance	0.01	CSF oral	61.25	500	0.01	**61**	**Risk-based**
7440315	Tin	Inorganic Substance	0.01	RfD oral	677.42	50000		**680**	**Risk-based**
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	3	RfD oral	203,225.81	500	0.005	**500**	**Ceiling Value**
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF oral	21.12	500	0.005	**21**	**Risk-based**
75694	Trichlorofluoromethane	Volatile Organic Substance	0.3	RfD oral	20,322.58	500	0.005	**500**	**Ceiling Value**
95954	Trichlorophenol, 2,4,5-	Semivolatile Organic Substance	0.1	RfD oral	6,774.19	1000	0.2	**1,000**	**Ceiling Value**
88062	Trichlorophenol, 2,4,6-	Semivolatile Organic Substance	0.011	CSF oral	55.68	1000	0.2	**56**	**Risk-based**
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.02	RfD oral	1,354.84	500	0.01	**500**	**Ceiling Value**
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.02	RfD oral	1,354.84	500	0.01	**500**	**Ceiling Value**
7440611	Uranium	Inorganic Substance	0.003	RfD oral	203.23	50000	1	**200**	**Risk-based**

Table 2: Residential Direct Exposure Criteria Calculation Table									
CASRN	**Substance**	**Type of Chemical**	**Recommended Toxicity Value**	**Type of Toxicity Value[1]**	**Calculated Risk-Based Value mg/kg**	**Ceiling Value mg/kg**	**Analytical Level for Soil mg/kg**	**Recommended Residential Direct Exposure Criteria mg/kg**	**Basis for Recommended Criteria**
108054	Vinyl acetate	Volatile Organic Substance	0.057	RfD oral	3,861.29	500	0.01	**500**	**Ceiling Value**

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

3 This criterion applies to all forms of Chlordane including alpha and gamma

4 This criterion applies to all forms of DDT including DDD and DDE

5 This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate

6 This criterion applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone

7 Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).

8 PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA)

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended I/C Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
83329	Acenaphthene	Semivolatile Organic Substance	0.06	RfD oral	122640.00	2500	0.2	**2,500**	**Ceiling Value**
75058	Acetonitrile	Volatile Organic Substance	0.005	RfD oral	10220.00	1000	0.005	**1,000**	**Ceiling Value**
107028	Acrolein	Volatile Organic Substance	0.0005	RfD oral	1022.00	1000	0.01	**1,000**	**Ceiling Value**
309002	Aldrin	Pesticide	17	CSF oral	0.34	1000	0.002	**0.34**	**Risk-based**
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance						**1,000**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance						**1,000**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C9-C18	Volatile Organic Substance						**1,000**	**DEEP 2012**[2]
	Aliphatic Hydrocarbons C19-C36	Semivolatile Organic Substance						**2,500**	**DEEP 2012**[2]
7429905	Aluminum	Inorganic Substance	1	RfD oral	2044000.00	50000	20	**50,000**	**Ceiling Value**
7664417	Ammonia	Inorganic Substance	0.1	RfD oral	204400.00	50000		**50,000**	**Ceiling Value**
62533	Aniline	Semivolatile Organic Substance	0.0057	CSF oral	1004.04	2500	0.2	**1,000**	**Risk-based**
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance						**1,000**	**DEEP 2012**[2]
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance						**1,000**	**DEEP 2012**[2]
92875	Benzidine	Semivolatile Organic Substance	230	CSF oral	0.02	2500	0.2	**0.20**	**Analytical Adjustment**
191242	Benzo(g,h,i)perylene	Semivolatile Organic Substance	0.073	CSF oral	78.40	2500	0.2	**78**	**Risk-based**
65850	Benzoic Acid	Semivolatile Organic Substance	4	RfD oral	8176000.00	2500	0.2	**2,500**	**Ceiling Value**
111911	Bis(2-chloroethoxy)methane	Semivolatile Organic Substance	0.003	RfD oral	6132.00	2500	0.2	**2,500**	**Ceiling Value**
7440428	Boron	Inorganic Substance	0.2	RfD oral	408800.00	50000	5	**50,000**	**Ceiling Value**
75274	Bromodichloromethane	Volatile Organic Substance	0.034	CSF oral	168.32	1000	0.005	**170**	**Risk-based**
74839	Bromomethane	Volatile Organic Substance	0.0005	RfD oral	1022.00	1000	0.005	**1,000**	**Ceiling Value**
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD oral	102200.00	1000	0.005	**1,000**	**Ceiling Value**
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD oral	102200.00	1000	0.005	**1,000**	**Ceiling Value**
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD oral	102200.00	1000	0.005	**1,000**	**Ceiling Value**

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended I/C Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
86748	Carbazole	Semivolatile Organic Substance	0.02	CSF oral	286.15	2500	0.2	**290**	**Risk-based**
75150	Carbon disulfide	Volatile Organic Substance	0.1	RfD oral	204400.00	1000	0.005	**1,000**	**Ceiling Value**
57749	Chlordane (Total)[3]	Pesticide	0.35	CSF oral	16.35	1000	0.002	**2.2**	**1996 RSRs**
7782505	Chlorine	Inorganic Substance	0.1	RfD oral	204400.00	50000		**50,000**	**Ceiling Value**
106478	Chloroaniline, 4-	Semivolatile Organic Substance	0.2	CSF oral	28.62	2500	0.2	**29**	**Risk-based**
75003	Chloroethane	Volatile Organic Substance	0.0047	CSF Oral	1217.66	1000	0.005	**1,000**	**Ceiling Value**
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD oral	5314.40	1000	0.05	**1,000**	**Ceiling Value**
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD oral	163520.00	1000	0.2	**1,000**	**Ceiling Value**
59507	Chlorophenol, 3-methyl-4	Semivolatile Organic Substance	0.1	RfD oral	204400.00	2500	0.2	**2,500**	**Ceiling Value**
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.02	RfD oral	40880.00	1000	0.2	**1,000**	**Ceiling Value**
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.02	RfD oral	40880.00	1000	0.2	**1,000**	**Ceiling Value**
218019	Chrysene	Semivolatile Organic Substance	0.0073	CSF oral	783.97	2500	0.2	**780**	**Risk-based**
7440484	Cobalt	Inorganic Substance	0.0003	RfD oral	613.20	50000	2	**610**	**Risk-based**
110827	Cyclohexane	Volatile Organic Substance	1.7	RfD oral	3474800.00	1000	0.005	**1,000**	**Ceiling Value**
53703	Dibenzo(a,h)anthracene	Semivolatile Organic Substance	7.3	CSF oral	0.78	2500	0.2	**1**	**Based on 1996 RSR PAH Values**
132649	Dibenzofuran	Volatile Organic Substance	0.001	RfD oral	2044.00	1000	0.2	**1,000**	**Ceiling Value**
96128	Dibromo-3-chloropropane, 1,2-	Semivolatile Organic Substance	7	CSF oral	0.82	2500	0.005	**0.82**	**Risk-based**
1918009	Dicamba	Pesticide	0.03	RfD oral	61320.00	1000	0.001	**1,000**	**Ceiling Value**
91941	Dichlorobenzidine, 3,3'-	Semivolatile Organic Substance	0.45	CSF oral	12.72	2500	0.2	**13**	**Risk-based**
75718	Dichlorodiflouromethane	Volatile Organic Substance	0.05	RfD oral	102200.00	1000	0.005	**1,000**	**Ceiling Value**
50293	Dichlorodiphenyl Trichloroethane, P, P'- (DDT) (Total) [4]	Pesticide	0.34	CSF oral	16.83	1000	0.003	**17**	**Risk-based**
120365	Dichloroprop	Pesticide	0.0036	RfD oral	7358.40	1000	0.005	**1,000**	**Ceiling Value**
84662	Diethyl phthalate	Semivolatile Organic Substance	0.8	RfD oral	1635200.00	2500	0.2	**2,500**	**Ceiling Value**

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended I/C Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
131113	Dimethyl phthalate	Semivolatile Organic Substance	10	RfD oral	20440000.00	2500	0.2	**2,500**	**Ceiling Value**
105679	Dimethylphenol, 2,4-	Semivolatile Organic Substance	0.02	RfD oral	40880.00	2500	0.2	**2,500**	**Ceiling Value**
51285	Dinitrophenol, 2,4-	Semivolatile Organic Substance	0.002	RfD oral	4088.00	2500	0.3	**2,500**	**Ceiling Value**
534521	Dinitrophenol, 2-methyl-4,6-	Semivolatile Organic Substance	0.0003	RfD oral	613.20	2500	0.3	**610**	**Risk-based**
121142	Dinitrotoluene, 2,4-	Semivolatile Organic Substance	0.68	CSF oral	8.42	2500	0.2	**8.4**	**Risk-based**
606202	Dinitrotoluene, 2,6-	Semivolatile Organic Substance	0.68	CSF oral	8.42	2500	0.2	**8.4**	**Risk-based**
123911	Dioxane, 1,4-	Semivolatile Organic Substance	0.1	CSF oral	57.23	2500	0.1	**57**	**Risk-based**
122667	Diphenylhydrazine, 1,2-	Semivolatile Organic Substance	0.8	CSF oral	7.15	2500	0.2	**7.2**	**Risk-based**
115297	Endosulfan (Total) [5]	Pesticide	0.0006	RfD oral	1226.40	1000	0.003	**1,000**	**Ceiling Value**
72208	Endrin(Total)[6]	Pesticide						**610**	**1996 RSRs**
64175	Ethanol	Semivolatile Organic Substance	0.067	RfD oral	136948.00	2500		**2,500**	**Ceiling Value**
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD oral	1839600.00	1000	0.005	**1,000**	**Ceiling Value**
107211	Ethylene glycol	Semivolatile Organic Substance	0.8	RfD oral	1635200.00	2500		**2,500**	**Ceiling Value**
50000	Formaldehyde	Semivolatile Organic Substance	0.02	RfD oral	40880.00	2500		**2,500**	**Ceiling Value**
87683	Hexachlorobutadiene	Semivolatile Organic Substance	0.0047	CSF oral	1217.66	2500	0.2	**1,200**	**Risk-based**
319846	Hexachlorocyclohexane, alpha	Pesticide	1.8	CSF oral	3.18	1000	0.002	**3.2**	**Risk-based**
319857	Hexachlorocyclohexane, beta-	Pesticide	1.8	CSF oral	3.18	1000	0.002	**3.2**	**Risk-based**
319868	Hexachlorocyclohexane, delta-	Pesticide	1.8	CSF oral	3.18	1000	0.002	**3.2**	**Risk-based**
77474	Hexachlorocyclopentadiene	Pesticide	0.006	RfD oral	12264.00	1000	0.2	**1,000**	**Ceiling Value**
110543	Hexane, n-	Volatile Organic Substance	0.06	RfD oral	122640.00	1000	0.005	**1,000**	**Ceiling Value**
591786	Hexanone-2	Volatile Organic Substance	0.005	RfD oral	10220.00	1000	0.2	**1,000**	**Ceiling Value**
193395	Indeno(1,2,3-c,d)pyrene	Semivolatile Organic Substance	0.73	CSF oral	7.84	2500	0.2	**7.8**	**Risk-based**
78591	Isophorone	Semivolatile Organic Substance	0.00095	CSF oral	6024.21	2500	0.2	**2,500**	**Ceiling Value**

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended I/C Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
67630	Isopropanol	Semivolatile Organic Substance	0.33	RfD oral	674520.00	2500	0.01	**2,500**	**Ceiling Value**
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD oral	204400.00	1000	0.005	**1,000**	**Ceiling Value**
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.03	RfD oral	61320.00	1000	0.005	**1,000**	**Ceiling Value**
7439932	Lithium	Inorganic Substance	0.002	RfD oral	4088.00	50000	5	**4,100**	**Risk-based**
7439965	Manganese	Inorganic Substance	0.05	RfD oral	102200.00	50000	1.5	**50,000**	**Ceiling Value**
67561	Methanol	Semivolatile Organic Substance	2	RfD oral	4088000.00	2500		**2,500**	**Ceiling Value**
80626	Methyl methacrylate	Volatile Organic Substance	0.14	RfD oral	286160.00	1000	0.005	**1,000**	**Ceiling Value**
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF oral	197.34	1000	0.2	**200**	**Risk-based**
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD oral	8176.00	1000	0.2	**1,000**	**Ceiling Value**
95487	Methylphenol, 2- (Cresol, o-)	Semivolatile Organic Substance	0.02	RfD oral	40880.00	2500	0.2	**2,500**	**Ceiling Value**
108394	Methylphenol, 3- (Cresol, m-)	Semivolatile Organic Substance	0.017	RfD oral	34748.00	2500	0.2	**2,500**	**Ceiling Value**
106445	Methylphenol, 4- (Cresol, p-)	Semivolatile Organic Substance	0.02	RfD oral	40880.00	2500	0.2	**2,500**	**Ceiling Value**
88744	Nitroaniline, 2-	Semivolatile Organic Substance	0.02	CSF oral	286.15	2500	0.3	**290**	**Risk-based**
99092	Nitroaniline, 3-	Semivolatile Organic Substance	0.02	CSF oral	286.15	2500	0.3	**290**	**Risk-based**
100016	Nitroaniline, 4-	Semivolatile Organic Substance	0.02	CSF oral	286.15	2500	0.3	**290**	**Risk-based**
98953	Nitrobenzene	Volatile Organic Substance	0.14	CSF oral	40.88	1000	0.2	**41**	**Risk-based**
62759	Nitrosodimethylamine, N-	Semivolatile Organic Substance	16	CSF oral	0.36	2500	0.2	**0.36**	**Risk-based**
621647	NitrosoDi-n-propylamine, N-	Semivolatile Organic Substance	7	CSF oral	0.82	2500	0.2	**0.82**	**Risk-based**
86306	Nitrosodiphenylamine, N-	Semivolatile Organic Substance	0.0049	CSF oral	1167.96	2500	0.2	**1168**	**Risk-based**
82688	Pentachloronitrobenzene	Semivolatile Organic Substance	0.001	RfD oral	2044.00	2500	0.005	**2044**	**Risk-based**
Various	Per- and Polyfluoroalkyl Substances (PFAS)[8]	Semivolatile Organic Substance	0.00002	RfD oral	40.88	2500	0.001	**41**	**Risk-based**
103651	Propylbenzene, n-	Volatile Organic Substance	0.1	RfD oral	204400.00	1000	0.005	**1,000**	**Ceiling Value**
57556	Propylene glycol	Semivolatile Organic Substance	20	RfD oral	40880000.00	2500	0.2	**2,500**	**Ceiling Value**

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-Based Value mg/kg	Ceiling Value mg/kg	Analytical Level for Soil mg/kg	Recommended I/C Direct Exposure Criteria mg/kg	Basis for Recommended Criteria
110861	Pyridine	Volatile Organic Substance	0.0003	RfD oral	613.20	1000	0.2	**610**	**Risk-based**
75650	Tert-butyl alcohol (Total Oxygenates)[7]	Semivolatile Organic Substance	0.017	RfD oral	34748.00	2500	0.025	**2,500**	**Ceiling Value**
95943	Tetrachlorobenzene, 1,2,4,5-	Semivolatile Organic Substance	0.0003	RfD oral	613.20	2500	0.01	**610**	**Risk-based**
109999	Tetrahydrofuran	Volatile Organic Substance	0.01	CSF oral	572.30	1000	0.01	**570**	**Risk-based**
7440315	Tin	Inorganic Substance	0.01	RfD oral	20440.00	50000		**20,400**	**Risk-based**
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	3	RfD oral	6132000.00	1000	0.005	**1,000**	**Ceiling Value**
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF oral	197.34	1000	0.005	**200**	**Risk-based**
75694	Trichlorofluoromethane	Volatile Organic Substance	0.3	RfD oral	613200.00	1000	0.005	**1,000**	**Ceiling Value**
95954	Trichlorophenol, 2,4,5-	Semivolatile Organic Substance	0.1	RfD oral	204400.00	2500	0.2	**2,500**	**Ceiling Value**
88062	Trichlorophenol, 2,4,6-	Semivolatile Organic Substance	0.011	CSF oral	520.27	2500	0.2	**520**	**Risk-based**
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.02	RfD oral	40880.00	1000	0.01	**1,000**	**Ceiling Value**
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.02	RfD oral	40880.00	1000	0.01	**1,000**	**Ceiling Value**
7440611	Uranium	Inorganic Substance	0.003	RfD oral	6132.00	50000	1	**6,100**	**Risk-based**
108054	Vinyl acetate	Volatile Organic Substance	0.057	RfD oral	116508.00	1000	0.01	**1,000**	**Ceiling Value**

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

3 This criterion applies to all forms of Chlordane including alpha and gamma

Table 3: Industrial/Commercial Direct Exposure Criteria Calculation Table									
CASRN	**Substance**	**Type of Chemical**	**Recommended Toxicity Value**	**Type of Toxicity Value[1]**	**Calculated Risk-Based Value mg/kg**	**Ceiling Value mg/kg**	**Analytical Level for Soil mg/kg**	**Recommended I/C Direct Exposure Criteria mg/kg**	**Basis for Recommended Criteria**
	4	This criterion applies to all forms of DDT including DDD and DDE							
	5	This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate							
	6	This criterion applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone							
	7	Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).							
	8	PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA)							

Table 4: Pollutant Mobility Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Groundwater Protection Criteria ug/l	Risk-based GA Pollutant Mobility Value	Risk-based GB Pollutant Mobility Value	Risk-based Pollutant Mobility Criteria Units	Analytical Level for Soil mg/kg	Analytical Level for Water ug/l	Recommended GA Pollutant Mobility Criteria	Basis GA Pollutant Mobility Criteria	Recommended GB Pollutant Mobility Criteria	Basis GB Pollutant Mobility Criteria	Recommended Pollutant Mobility Criteria Units
83329	Acenaphthene	Semivolatile Organic Substance	420	8.40	84.00	mg/kg	0.2	0.1	**8.4**	**GWPC**	**84**	**GWPC**	**mg/kg**
75058	Acetonitrile	Volatile Organic Substance	35	0.70	7.00	mg/kg	0.005	10	**0.70**	**GWPC**	**7.0**	**GWPC**	**mg/kg**
107028	Acrolein	Volatile Organic Substance	10	0.20	2.00	mg/kg	0.01	10	**0.20**	**GWPC**	**2.0**	**GWPC**	**mg/kg**
309002	Aldrin	Pesticide	0.05	0.001	0.010	mg/kg	0.002	0.05	**0.002**	**Analytical Adjustment**	**0.01**	**GWPC**	**mg/kg**
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance							**6**	**DEEP 2012[1]**	**55**	**DEEP 2012**	**mg/kg**
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance							**15**	**DEEP 2012[1]**	**140**	**DEEP 2012**	**mg/kg**
	Aliphatic Hydrocarbons C9-C18	Semivolatile Organic Substance							**20**	**DEEP 2012[1]**	**140**	**DEEP 2012**	**mg/kg**
	Aliphatic Hydrocarbons C19-C36	Semivolatile Organic Substance							**20**	**DEEP 2012[1]**	**200**	**DEEP 2012**	**mg/kg**
7429905	Aluminum	Inorganic Substance	50	0.05	0.50	mg/l	20	20	**0.05**	**GWPC**	**0.50**	**GWPC**	**mg/l**
7664417	Ammonia	Inorganic Substance	700	0.70	7.00	mg/l		20	**0.70**	**GWPC**	**7.0**	**GWPC**	**mg/l**
62533	Aniline	Semivolatile Organic Substance	6.1	0.12	1.23	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.2**	**GWPC**	**mg/kg**
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance							**5**	**DEEP 2012**	**20**	**DEEP 2012**	**mg/kg**
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance							**20**	**DEEP 2012**	**30**	**DEEP 2012**	**mg/kg**
92875	Benzidine	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
191242	Benzo(g,h,i)perylene	Semivolatile Organic Substance	0.48	0.01	0.10	mg/kg	0.2	0.1	**1**	**Based on 1996 RSR PAH**	**1**	**Based on 1996 RSR PAH**	**mg/kg**
65850	Benzoic Acid	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg	0.2	5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
111911	Bis(2-chloroethoxy)methane	Semivolatile Organic Substance	21	0.42	4.20	mg/kg	0.2	5	**0.42**	**GWPC**	**4.2**	**GWPC**	**mg/kg**
7440428	Boron	Inorganic Substance	1,000	1.00	10.00	mg/l	5	50	**1.0**	**GWPC**	**10**	**GWPC**	**mg/l**
75274	Bromodichloromethane	Volatile Organic Substance	1.0	0.02	0.21	mg/kg	0.005	0.5	**0.02**	**GWPC**	**0.21**	**GWPC**	**mg/kg**
74839	Bromomethane	Volatile Organic Substance	3.5	0.07	0.70	mg/kg	0.005	0.5	**0.07**	**GWPC**	**0.70**	**GWPC**	**mg/kg**
104518	Butylbenzene, n-	Volatile Organic Substance	350	7.00	70.00	mg/kg	0.005	0.5	**7.0**	**GWPC**	**70**	**GWPC**	**mg/kg**
135988	Butylbenzene, sec-	Volatile Organic Substance	350	7.00	70.00	mg/kg	0.005	0.5	**7.0**	**GWPC**	**70**	**GWPC**	**mg/kg**
98066	Butylbenzene, t-	Volatile Organic Substance	350	7.00	70.00	mg/kg	0.005	0.5	**7.0**	**GWPC**	**70**	**GWPC**	**mg/kg**
86748	Carbazole	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
75150	Carbon disulfide	Volatile Organic Substance	40	0.80	8.00	mg/kg	0.005	0.5	**0.80**	**GWPC**	**8.0**	**GWPC**	**mg/kg**

Table 4: Pollutant Mobility Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Groundwater Protection Criteria ug/l	Risk-based GA Pollutant Mobility Value	Risk-based GB Pollutant Mobility Value	Risk-based Pollutant Mobility Criteria Units	Analytical Level for Soil mg/kg	Analytical Level for Water ug/l	Recommended GA Pollutant Mobility Criteria	Basis GA Pollutant Mobility Criteria	Recommended GB Pollutant Mobility Criteria	Basis GB Pollutant Mobility Criteria	Recommended Pollutant Mobility Criteria Units
57749	Chlordane(Total)[2]	Pesticide	0.30						**0.066**	**1996 RSR**	**0.066**	**1996 RSR**	**mg/kg**
7782505	Chlorine	Inorganic Substance	4,000	4.00	40.00	mg/l		20	**4.0**	**GWPC**	**40**	**GWPC**	**mg/l**
106478	Chloroaniline, 4-	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
75003	Chloroethane	Volatile Organic Substance	7.4	0.15	1.49	mg/kg	0.005	0.5	**0.15**	**GWPC**	**1.5**	**GWPC**	**mg/kg**
74873	Chloromethane	Volatile Organic Substance	18	0.36	3.64	mg/kg	0.05	0.5	**0.36**	**GWPC**	**3.6**	**GWPC**	**mg/kg**
91587	Chloronapthalene, 2-	Semivolatile Organic Substance	560	11.20	112.00	mg/kg	0.2	5	**11**	**GWPC**	**110**	**GWPC**	**mg/kg**
59507	Chlorophenol, 3-methyl-4	Semivolatile Organic Substance	700	14.00	140.00	mg/kg	0.2	5	**14**	**GWPC**	**140**	**GWPC**	**mg/kg**
95498	Chlorotoluene, 2-	Volatile Organic Substance	140	2.80	28.00	mg/kg	0.2	0.5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
106434	Chlorotoluene, 4-	Volatile Organic Substance	140	2.80	28.00	mg/kg	0.2	0.5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
218019	Chrysene	Semivolatile Organic Substance	4.8	0.096	0.96	mg/kg	0.2	0.1	**1**	**Based on 1996 RSR PAH**	**1**	**Based on 1996 RSR PAH**	**mg/kg**
7440484	Cobalt	Inorganic Substance	2.1	0.002	0.02	mg/l	2	1	**0.002**	**GWPC**	**0.02**	**GWPC**	**mg/l**
110827	Cyclohexane	Volatile Organic Substance	1,000	20.00	200.00	mg/kg	0.005	0.5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
53703	Dibenzo(a,h)anthracene	Semivolatile Organic Substance	0.10	0.002	0.02	mg/kg	0.2	0.1	**1**	**Based on 1996 RSR PAH**	**1**	**Based on 1996 RSR PAH**	**mg/kg**
132649	Dibenzofuran	Volatile Organic Substance	7.0	0.14	1.40	mg/kg	0.2	0.5	**0.20**	**Analytical Adjustment**	**1.4**	**GWPC**	**mg/kg**
96128	Dibromo-3-chloropropane, 1,2-	Semivolatile Organic Substance	0.20	0.004	0.04	mg/kg	0.005	0.05	**0.005**	**Analytical Adjustment**	**0.04**	**GWPC**	**mg/kg**
1918009	Dicamba	Pesticide	210	4.20	42.00	mg/kg	0.001	0.03	**4.2**	**GWPC**	**42**	**GWPC**	**mg/kg**
91941	Dichlorobenzidine, 3,3'-	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
75718	Dichlorodiflouromethane	Volatile Organic Substance	350	7.00	70.00	mg/kg	0.005	0.5	**7.0**	**GWPC**	**70**	**GWPC**	**mg/kg**
50293	Dichlorodiphenyl Trichloroethane, P, P'-(DDT) (Total)[3]	Pesticide	0.10	0.002	0.02	mg/kg	0.003	0.05	**0.003**	**Analytical Adjustment**	**0.02**	**GWPC**	**mg/kg**
120365	Dichloroprop	Pesticide	25	0.50	5.04	mg/kg	0.005	0.5	**0.50**	**GWPC**	**5.0**	**GWPC**	**mg/kg**
84662	Diethyl phthalate	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg	0.2	5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
131113	Dimethyl phthalate	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg	0.2	5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
105679	Dimethylphenol, 2,4-	Semivolatile Organic Substance	140	2.80	28.00	mg/kg	0.2	5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
51285	Dinitrophenol, 2,4-	Semivolatile Organic Substance	14	0.28	2.80	mg/kg	0.3	10	**0.30**	**Analytical Adjustment**	**2.8**	**GWPC**	**mg/kg**
534521	Dinitrophenol, 2-methyl-4,6-	Semivolatile Organic Substance	10	0.20	2.00	mg/kg	0.3	10	**0.30**	**Analytical Adjustment**	**2.0**	**GWPC**	**mg/kg**

Table 4: Pollutant Mobility Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Groundwater Protection Criteria ug/l	Risk-based GA Pollutant Mobility Value	Risk-based GB Pollutant Mobility Value	Risk-based Pollutant Mobility Criteria Units	Analytical Level for Soil mg/kg	Analytical Level for Water ug/l	Recommended GA Pollutant Mobility Criteria	Basis GA Pollutant Mobility Criteria	Recommended GB Pollutant Mobility Criteria	Basis GB Pollutant Mobility Criteria	Recommended Pollutant Mobility Criteria Units
121142	Dinitrotoluene, 2,4-	Semivolatile Organic Substance	5.0	0.100	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
606202	Dinitrotoluene, 2,6-	Semivolatile Organic Substance	5.0	0.100	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
123911	Dioxane, 1,4-	Semivolatile Organic Substance	3.0	0.06	0.60	mg/kg	0.1	3	**0.10**	**Analytical Adjustment**	**0.60**	**GWPC**	**mg/kg**
122667	Diphenylhydrazine, 1,2-	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
115297	Endosulfan (Total)[4]	Pesticide	4.2	0.084	0.84	mg/kg	0.003	0.05	**0.084**	**GWPC**	**0.84**	**GWPC**	**mg/kg**
7421934	Endrin (Total)[5]	Pesticide	2.0	0.04	0.40	mg/kg	0.003	0.05	**0.04**	**GWPC**	**0.40**	**GWPC**	**mg/kg**
64175	Ethanol	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg		1000	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
141786	Ethyl acetate	Volatile Organic Substance	1,000	20.00	200.00	mg/kg	0.005	0.5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
107211	Ethylene glycol	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg		1000	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
50000	Formaldehyde	Semivolatile Organic Substance	140	2.80	28.00	mg/kg		50	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
87683	Hexachlorobutadiene	Semivolatile Organic Substance	7.4	0.15	1.48	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.5**	**GWPC**	**mg/kg**
319846	Hexachlorocyclohexane, alpha	Pesticide	0.050	0.001	0.01	mg/kg	0.002	0.05	**0.002**	**Analytical Adjustment**	**0.01**	**GWPC**	**mg/kg**
319857	Hexachlorocyclohexane, beta-	Pesticide	0.050	0.001	0.01	mg/kg	0.002	0.05	**0.002**	**Analytical Adjustment**	**0.01**	**GWPC**	**mg/kg**
319868	Hexachlorocyclohexane, delta-	Pesticide	0.050	0.001	0.01	mg/kg	0.002	0.05	**0.002**	**Analytical Adjustment**	**0.01**	**GWPC**	**mg/kg**
77474	Hexachlorocyclopentadiene	Pesticide	42	0.84	8.40	mg/kg	0.2	0.05	**0.84**	**GWPC**	**8.4**	**GWPC**	**mg/kg**
110543	Hexane, n-	Volatile Organic Substance	420	8.40	84.00	mg/kg	0.005	0.1	**8.4**	**GWPC**	**84**	**GWPC**	**mg/kg**
591786	Hexanone, 2-	Volatile Organic Substance	35	0.70	7.00	mg/kg	0.2	0.1	**0.70**	**GWPC**	**7.0**	**GWPC**	**mg/kg**
193395	Indeno(1,2,3-c,d)pyrene	Semivolatile Organic Substance	0.10	0.002	0.02	mg/kg	0.2	0.1	**1**	**Based on 1996 RSR PAH**	**1**	**Based on 1996 RSR PAH**	**mg/kg**
78591	Isophorone	Semivolatile Organic Substance	37	0.74	7.37	mg/kg	0.2	5	**0.74**	**GWPC**	**7.4**	**GWPC**	**mg/kg**
67630	Isopropanol	Semivolatile Organic Substance	2,300	46.00	460.00	mg/kg	0.01	200	**46**	**GWPC**	**460**	**GWPC**	**mg/kg**
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	25	0.50	5.00	mg/kg	0.005	0.5	**0.50**	**GWPC**	**5.0**	**GWPC**	**mg/kg**
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	25	0.50	5.00	mg/kg	0.005	0.5	**0.50**	**GWPC**	**5.0**	**GWPC**	**mg/kg**
7439932	Lithium	Inorganic Substance	14	0.01	0.14	mg/l	5	10	**0.014**	**GWPC**	**0.14**	**GWPC**	**mg/l**
7439965	Manganese	Inorganic Substance	500	0.50	5.00	mg/l	1.5	15	**0.50**	**GWPC**	**5.0**	**GWPC**	**mg/l**
67561	Methanol	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg		1000	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**

Table 4: Pollutant Mobility Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Groundwater Protection Criteria ug/l	Risk-based GA Pollutant Mobility Value	Risk-based GB Pollutant Mobility Value	Risk-based Pollutant Mobility Criteria Units	Analytical Level for Soil mg/kg	Analytical Level for Water ug/l	Recommended GA Pollutant Mobility Criteria	Basis GA Pollutant Mobility Criteria	Recommended GB Pollutant Mobility Criteria	Basis GB Pollutant Mobility Criteria	Recommended Pollutant Mobility Criteria Units
80626	Methyl methacrylate	Volatile Organic Substance	980	19.60	196.00	mg/kg	0.005	0.5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
90120	Methylnaphthalene, 1-	Volatile Organic Substance	5	0.10	1.00	mg/kg	0.2	1	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
91576	Methylnaphthalene, 2-	Volatile Organic Substance	28	0.56	5.60	mg/kg	0.2	5	**0.56**	**GWPC**	**5.6**	**GWPC**	**mg/kg**
95487	Methylphenol, 2- (Cresol, o-)	Semivolatile Organic Substance	140	2.80	28.00	mg/kg	0.2	5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
108394	Methylphenol, 3- (Cresol, m-)	Semivolatile Organic Substance	119	2.38	23.80	mg/kg	0.2	5	**2.4**	**Analytical Adjustment**	**24**	**Analytical Adjustment**	**mg/kg**
106445	Methylphenol, 4- (Cresol, p-)	Semivolatile Organic Substance	140	2.80	28.00	mg/kg	0.2	5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
88744	Nitroaniline, 2-	Semivolatile Organic Substance	10	0.20	2.00	mg/kg	0.3	10	**0.30**	**Analytical Adjustment**	**2.0**	**GWPC**	**mg/kg**
99092	Nitroaniline, 3-	Semivolatile Organic Substance	10	0.20	2.00	mg/kg	0.3	10	**0.30**	**Analytical Adjustment**	**2.0**	**GWPC**	**mg/kg**
100016	Nitroaniline, 4-	Semivolatile Organic Substance	10	0.20	2.00	mg/kg	0.3	10	**0.30**	**Analytical Adjustment**	**2.0**	**GWPC**	**mg/kg**
98953	Nitrobenzene	Volatile Organic Substance	5	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
62759	Nitrosodimethylamine, N-	Semivolatile Organic Substance	5.0	0.100	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
621647	NitrosoDi-n-propylamine, N-	Semivolatile Organic Substance	5.0	0.100	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
86306	Nitrosodiphenylamine, N-	Semivolatile Organic Substance	7.1	0.020	1.43	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.4**	**GWPC**	**mg/kg**
82688	Pentachloronitrobenzene	Semivolatile Organic Substance	7.0	0.14	1.40	mg/kg	0.005	5	**0.14**	**GWPC**	**1.4**	**GWPC**	**mg/kg**
Various	Per- and Polyfluoroalkyl Substances (PFAS)[7]	Semivolatile Organic Substance	0.070	0.0014	0.014	mg/kg	0.001	0.01	**0.0014**	**GWPC**	**0.014**	**GWPC**	**mg/kg**
103651	Propylbenzene, n-	Volatile Organic Substance	50	1.00	10.00	mg/kg	0.005	0.5	**1.0**	**GWPC**	**10**	**GWPC**	**mg/kg**
57556	Propylene glycol	Semivolatile Organic Substance	1,000	20.00	200.00	mg/kg	0.2	1000	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
110861	Pyridine	Volatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
	Sulfide	Inorganic Substance	1.0	0.00	0.01	mg/l	0.00003		**0.00**	**GWPC**	**0.01**	**GWPC**	**mg/l**
75650	Tert-butyl alcohol (Total Oxygenates)[6]	Semivolatile Organic Substance	100	2.00	20.00	mg/kg	0.025	100	**2.0**	**GWPC**	**20**	**GWPC**	**mg/kg**
95943	Tetrachlorobenzene, 1,2,4,5-	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.01	5	**0.10**	**GWPC**	**1.0**	**GWPC**	**mg/kg**
109999	Tetrahydrofuran	Volatile Organic Substance	4	0.08	0.80	mg/kg	0.01	1	**0.08**	**GWPC**	**0.80**	**GWPC**	**mg/kg**
7440315	Tin	Inorganic Substance	70	0.07	0.70	mg/l	0.01	20	**0.07**	**GWPC**	**0.70**	**GWPC**	**mg/l**
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	1,000	20.00	200.00	mg/kg	0.005	0.5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	70	1.40	14.00	mg/kg	0.005	0.5	**1.4**	**GWPC**	**14**	**GWPC**	**mg/kg**

Table 4: Pollutant Mobility Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Groundwater Protection Criteria ug/l	Risk-based GA Pollutant Mobility Value	Risk-based GB Pollutant Mobility Value	Risk-based Pollutant Mobility Criteria Units	Analytical Level for Soil mg/kg	Analytical Level for Water ug/l	Recommended GA Pollutant Mobility Criteria	Basis GA Pollutant Mobility Criteria	Recommended GB Pollutant Mobility Criteria	Basis GB Pollutant Mobility Criteria	Recommended Pollutant Mobility Criteria Units
75694	Trichlorofluoromethane	Volatile Organic Substance	1,000	20.00	200.00	mg/kg	0.005	0.5	**20**	**GWPC**	**200**	**GWPC**	**mg/kg**
95954	Trichlorophenol, 2,4,5-	Semivolatile Organic Substance	700	14.00	140.00	mg/kg	0.2	5	**14**	**GWPC**	**140**	**GWPC**	**mg/kg**
88062	Trichlorophenol, 2,4,6-	Semivolatile Organic Substance	5.0	0.10	1.00	mg/kg	0.2	5	**0.20**	**Analytical Adjustment**	**1.0**	**GWPC**	**mg/kg**
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	140	2.80	28.00	mg/kg	0.01	0.5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	140	2.80	28.00	mg/kg	0.01	0.5	**2.8**	**GWPC**	**28**	**GWPC**	**mg/kg**
7440611	Uranium	Inorganic Substance	30	0.03	0.30	mg/l	1	10	**0.03**	**GWPC**	**0.30**	**GWPC**	**mg/l**
108054	Vinyl acetate	Volatile Organic Substance	399	7.98	79.80	mg/kg	0.01	0.5	**8.0**	**GWPC**	**80**	**GWPC**	**mg/kg**

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at: http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

2 This criteron applies to all forms of Chlordane including alpha and gamma

3 This criterion applies to all forms of DDT including DDD and DDE

4 This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate

5 This criterion applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone

6 Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).

7 PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA)

Table 5: Groundwater Protection Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-based Value ug/l	Federal MCL ug/l[2]	CT Action Level[3] ug/l	Taste or Odor Threshold ug/l	Ceiling Value ug/l	Analytical Level for Water ug/l	Recommended Groundwater Protection Criteria ug/l	Basis for Recommended Criteria
83329	Acenaphthene	Semivolatile Organic Substance	0.06	RfD oral	420.00				1000	0.1	**420**	**Risk-based**
75058	Acetonitrile	Volatile Organic Substance	0.005	RfD oral	35.00				1000	10	**35**	**Risk-based**
107028	Acrolein	Volatile Organic Substance	0.0005	RfD oral	3.50				1000	10	**10**	**Analytical Adjustment**
309002	Aldrin	Pesticide	17	CSF oral	0.002				1000	0.05	**0.05**	**Analytical Adjustment**
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance									**280**	**DEEP 2012[4]**
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance									**700**	**DEEP 2012[4]**
	Aliphatic Hydrocarbons C9-C18	Volatile Organic Substance									**700**	**DEEP 2012[4]**
	Aliphatic Hydrocarbons C19-C36	Semivolatile Organic Substance									**1,000**	**DEEP 2012[4]**
7429905	Aluminum	Inorganic Substance	1	RfD oral	7,000.00	50-200			1000	20	**50**	**Secondary MCL**
7664417	Ammonia	Inorganic Substance	0.1	RfD oral	700.00			1,500	1000	20	**700**	**Risk-based**
62533	Aniline	Semivolatile Organic Substance	0.0057	CSF oral	6.14				1000	5	**6.1**	**Risk-based**
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance									**100**	**DEEP 2012**
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance									**140**	**DEEP 2012**
92875	Benzidine	Semivolatile Organic Substance	230	CSF oral	0.0002				1000	5	**5.0**	**Analytical Adjustment**
191242	Benzo(g,h,i)perylene	Semivolatile Organic Substance	0.073	CSF oral	0.48				1000	0.1	**0.48**	**Risk-based**
65850	Benzoic Acid	Semivolatile Organic Substance	4	RfD oral	28,000.00				1000	5	**1,000**	**Ceiling Value**
111911	Bis(2-chloroethoxy)methane	Semivolatile Organic Substance	0.003	RfD oral	21.00				1000	5	**21**	**Risk-based**
7440428	Boron	Inorganic Substance	0.2	RfD oral	1,400.00				1000	50	**1,000**	**Ceiling Value**
75274	Bromodichloromethane	Volatile Organic Substance	0.034	CSF oral	1.03				1000	0.5	**1.0**	**Risk-based**
74839	Bromomethane	Volatile Organic Substance	0.0005	RfD oral	3.50				1000	0.5	**3.5**	**Risk-based**
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD oral	350.00				1000	0.5	**350**	**Risk-based**
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD oral	350.00				1000	0.5	**350**	**Risk-based**
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD oral	350.00				1000	0.5	**350**	**Risk-based**
86748	Carbazole	Semivolatile Organic Substance	0.02	CSF oral	1.75				1000	5	**5.0**	**Analytical Adjustment**
75150	Carbon disulfide	Volatile Organic Substance	0.1	RfD oral	700.00			40	1000	0.5	**40**	**Taste/Odor Threshold**
5103719	Chlordane (Total)[5]	Pesticide				2	0.30				**0.30**	**1996 RSR**

Table 5: Groundwater Protection Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-based Value ug/l	Federal MCL ug/l[2]	CT Action Level[3] ug/l	Taste or Odor Threshold ug/l	Ceiling Value ug/l	Analytical Level for Water ug/l	Recommended Groundwater Protection Criteria ug/l	Basis for Recommended Criteria
7782505	Chlorine	Inorganic Substance	0.1	RfD oral	700.00	4000			1000	20	**4,000**	**MCL**
106478	Chloroaniline, 4-	Semivolatile Organic Substance	0.2	CSF oral	0.18				1000	5	**5.0**	**Analytical Adjustment**
75003	Chloroethane	Volatile Organic Substance	0.0047	CSF Oral	7.45				1000	0.5	**7.4**	**Risk-based**
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD oral	18.20				1000	0.5	**18**	**Risk-based**
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD oral	560.00				1000	5	**560**	**Risk-based**
59507	Chlorophenol, 3-methyl-4	Semivolatile Organic Substance	0.1	RfD oral	700.00				1000	5	**700**	**Risk-based**
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.02	RfD oral	140.00			190	1000	0.5	**140**	**Risk-based**
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.02	RfD oral	140.00			190	1000	0.5	**140**	**Risk-based**
218019	Chrysene	Semivolatile Organic Substance	0.0073	CSF oral	4.79				1000	0.1	**4.8**	**Risk-based**
7440484	Cobalt	Inorganic Substance	0.0003	RfD oral	2.10				1000	1	**2.1**	**Risk-based**
110827	Cyclohexane	Volatile Organic Substance	1.7	RfD oral	11,900.00				1000	0.5	**1,000**	**Ceiling Value**
72548	Dibenzo(a,h)anthracene	Semivolatile Organic Substance	7.3	CSF oral	0.005				1000	0.1	**0.10**	**Analytical Adjustment**
72559	Dibenzofuran	Volatile Organic Substance	0.001	RfD oral	7.00				1000	0.5	**7.0**	**Risk-based**
50293	Dibromo-3-chloropropane, 1,2-	Semivolatile Organic Substance	7	CSF oral	0.01	0.20			1000	0.05	**0.20**	**MCL**
53703	Dicamba	Pesticide	0.03	RfD oral	210.00				1000	0.03	**210**	**Risk-based**
132649	Dichlorobenzidine, 3,3'-	Semivolatile Organic Substance	0.45	CSF oral	0.08				1000	5	**5.0**	**Analytical Adjustment**
1918009	Dichlorodiflouromethane	Volatile Organic Substance	0.05	RfD oral	350.00				1000	0.5	**350**	**Risk-based**
75718	Dichlorodiphenyl Trichloroethane, P, P'-(DDT) (Total)[6]	Pesticide	0.34	CSF oral	0.10				1000	0.05	**0.10**	**Risk-based**
120365	Dichloroprop	Pesticide	0.0036	RfD oral	25.20				1000	0.5	**25**	**Risk-based**
84662	Diethyl phthalate	Semivolatile Organic Substance	0.8	RfD oral	5,600.00				1000	5	**1,000**	**Ceiling Value**
131113	Dimethyl phthalate	Semivolatile Organic Substance	10	RfD oral	70,000.00				1000	5	**1,000**	**Ceiling Value**
105679	Dimethylphenol, 2,4-	Semivolatile Organic Substance	0.02	RfD oral	140.00				1000	5	**140**	**Risk-based**
51285	Dinitrophenol, 2,4-	Semivolatile Organic Substance	0.002	RfD oral	14.00				1000	10	**14**	**Risk-based**
534521	Dinitrophenol, 2-methyl-4,6-	Semivolatile Organic Substance	0.0003	RfD oral	2.10				1000	10	**10**	**Analytical Adjustment**
121142	Dinitrotoluene, 2,4-	Semivolatile Organic Substance	0.68	CSF oral	0.05				1000	5	**5.0**	**Analytical Adjustment**
606202	Dinitrotoluene, 2,6-	Semivolatile Organic Substance	0.68	CSF oral	0.05				1000	5	**5.0**	**Analytical Adjustment**

Table 5: Groundwater Protection Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-based Value ug/l	Federal MCL ug/l[2]	CT Action Level[3] ug/l	Taste or Odor Threshold ug/l	Ceiling Value ug/l	Analytical Level for Water ug/l	Recommended Groundwater Protection Criteria ug/l	Basis for Recommended Criteria
123911	Dioxane, 1,4-	Semivolatile Organic Substance	0.1	CSF oral	0.35		3		1000	0.5	**3.0**	**Action Level**
122667	Diphenylhydrazine, 1,2-	Semivolatile Organic Substance	0.8	CSF oral	0.04				1000	5	**5.0**	**Analytical Adjustment**
115297	Endosulfan (total)[7]	Pesticide	0.0006	RfD oral	4.20				1000	0.05	**4.2**	**Risk-based**
72208	Endrin (Total)[8]	Pesticide	0.0003	RfD oral	2.10	2	2		1000	0.05	**2.0**	**Action Level**
64175	Ethanol	Semivolatile Organic Substance	0.067	RfD oral	469.00				1000	1000	**1,000**	**Ceiling Value**
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD oral	6,300.00				1000	0.5	**1,000**	**Ceiling Value**
107211	Ethylene glycol	Semivolatile Organic Substance	0.8	RfD oral	5,600.00				1000	1000	**1,000**	**Ceiling Value**
50000	Formaldehyde	Semivolatile Organic Substance	0.02	RfD oral	140.00				1000	50	**140**	**Risk-based**
87683	Hexachlorobutadiene	Semivolatile Organic Substance	0.0047	CSF oral	7.45				1000	5	**7.4**	**Risk-based**
319846	Hexachlorocyclohexane, alpha	Pesticide	1.8	CSF oral	0.02				1000	0.05	**0.05**	**Analytical Adjustment**
319857	Hexachlorocyclohexane, beta-	Pesticide	1.8	CSF oral	0.02				1000	0.05	**0.05**	**Analytical Adjustment**
319868	Hexachlorocyclohexane, delta-	Pesticide	1.8	CSF oral	0.02				1000	0.05	**0.05**	**Analytical Adjustment**
77474	Hexachlorocyclopentadiene	Pesticide	0.006	RfD oral	42.00				1000	0.05	**42**	**Risk-based**
110543	Hexane, n-	Volatile Organic Substance	0.06	RfD oral	420.00				1000	0.1	**420**	**Risk-based**
591786	Hexanone, 2-	Volatile Organic Substance	0.005	RfD oral	35.00				1000	5	**35**	**Risk-based**
193395	Indeno(1,2,3-c,d)pyrene	Semivolatile Organic Substance	0.73	CSF oral	0.05				1000	0.1	**0.10**	**Analytical Adjustment**
78591	Isophorone	Semivolatile Organic Substance	0.00095	CSF oral	36.84				1000	5	**37**	**Risk-based**
67630	Isopropanol	Semivolatile Organic Substance	0.33	RfD oral	2,310.00		2300		1000	200	**2,300**	**Action Level**
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD oral	700.00			25	1000	0.5	**25**	**Odor Threshold**
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.03	RfD oral	210.00			25	1000	0.5	**25**	**Odor Threshold**
7439932	Lithium	Inorganic Substance	0.002	RfD oral	14.00				1000	10	**14**	**Risk-based**
7439965	Manganese	Inorganic Substance	0.05	RfD oral	350.00	50	500		1000	15	**500**	**Action Level**
67561	Methanol	Semivolatile Organic Substance	2	RfD oral	14,000.00				1000	1000	**1,000**	**Ceiling Value**
80626	Methyl methacrylate	Volatile Organic Substance	0.14	RfD oral	980.00				1000	0.5	**980**	**Risk-based**
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF oral	1.21				1000	5	**5**	**Analytical Adjustment**
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD oral	28.00				1000	5	**28**	**Risk-based**

Table 5: Groundwater Protection Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-based Value ug/l	Federal MCL ug/l[2]	CT Action Level[3] ug/l	Taste or Odor Threshold ug/l	Ceiling Value ug/l	Analytical Level for Water ug/l	Recommended Groundwater Protection Criteria ug/l	Basis for Recommended Criteria
95487	Methylphenol, 2- (Cresol, o-)	Semivolatile Organic Substance	0.02	RfD oral	140.00				1000	5	**140**	**Risk-based**
108394	Methylphenol, 3- (Cresol, m-)	Semivolatile Organic Substance	0.017	RfD oral	119.00				1000	5	**120**	**Risk-based**
106445	Methylphenol, 4- (Cresol, p-)	Semivolatile Organic Substance	0.02	RfD oral	140.00				1000	5	**140**	**Risk-based**
88744	Nitroaniline, 2-	Semivolatile Organic Substance	0.02	CSF oral	1.75				1000	10	**10**	**Analytical Adjustment**
99092	Nitroaniline, 3-	Semivolatile Organic Substance	0.02	CSF oral	1.75				1000	10	**10**	**Analytical Adjustment**
100016	Nitroaniline, 4-	Semivolatile Organic Substance	0.02	CSF oral	1.75				1000	10	**10**	**Analytical Adjustment**
98953	Nitrobenzene	Volatile Organic Substance	0.14	CSF oral	0.25				1000	5	**5**	**Analytical Adjustment**
62759	Nitrosodimethylamine, N-	Semivolatile Organic Substance	16	CSF oral	0.00				1000	5	**5.0**	**Analytical Adjustment**
621647	NitrosoDi-n-propylamine, N-	Semivolatile Organic Substance	7	CSF oral	0.01				1000	5	**5.0**	**Analytical Adjustment**
86306	Nitrosodiphenylamine, N-	Semivolatile Organic Substance	0.0049	CSF oral	7.14				1000	5	**7.1**	**Risk-based**
82688	Pentachloronitrobenzene	Semivolatile Organic Substance	0.001	RfD oral	7.00				1000	5	**7.0**	**Risk-based**
Various	Per- and Polyfluoroalkyl Substances (PFAS)[10]	Semivolatile Organic Substance	0.00002	RfD oral	0.14		0.070		1000	0.01	**0.070**	**Action Level**
103651	Propylbenzene, n-	Volatile Organic Substance	0.1	RfD oral	700.00			50	1000	0.5	**50**	**Taste / Odor Threshold**
57556	Propylene glycol	Semivolatile Organic Substance	20	RfD oral	140,000.00				1000	1000	**1,000**	**Ceiling Value**
110861	Pyridine	Volatile Organic Substance	0.0003	RfD oral	2.10			71	1000	5	**5.0**	**Analytical Adjustment**
75650	Tert-butyl alcohol (Total oxygenates)[9]	Semivolatile Organic Substance	0.017	RfD oral	119.00		100		1000	100	**100**	**Action Level**
95943	Tetrachlorobenzene, 1,2,4,5-	Semivolatile Organic Substance	0.0003	RfD oral	2.10				1000	5	**5.0**	**Analytical Adjustment**
109999	Tetrahydrofuran	Volatile Organic Substance	0.01	CSF oral	3.50				1000	1	**4**	**Risk-based**
7440315	Tin	Inorganic Substance	0.01	RfD oral	70.00				1000	20	**70**	**Risk-based**
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	3	RfD oral	21,000.00				1000	0.5	**1,000**	**Ceiling Value**
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF oral	1.21	70			1000	0.5	**70**	**MCL**
75694	Trichlorofluoromethane	Volatile Organic Substance	0.3	RfD oral	2,100.00				1000	0.5	**1,000**	**Ceiling Value**
95954	Trichlorophenol, 2,4,5-	Semivolatile Organic Substance	0.1	RfD oral	700.00				1000	5	**700**	**Risk-based**
88062	Trichlorophenol, 2,4,6-	Semivolatile Organic Substance	0.011	CSF oral	3.18				1000	5	**5.0**	**Analytical Adjustment**
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.02	RfD oral	140.00				1000	0.5	**140**	**Risk-based**

Table 5: Groundwater Protection Criteria Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Calculated Risk-based Value ug/l	Federal MCL ug/l[2]	CT Action Level[3] ug/l	Taste or Odor Threshold ug/l	Ceiling Value ug/l	Analytical Level for Water ug/l	Recommended Groundwater Protection Criteria ug/l	Basis for Recommended Criteria
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.02	RfD oral	140.00				1000	0.5	**140**	**Risk-based**
7440611	Uranium	Inorganic Substance	0.003	RfD oral	21.00	30			1000	10	**30**	**MCL**
108054	Vinyl acetate	Volatile Organic Substance	0.057	RfD oral	399.00			715	1000	0.5	**400**	**Risk-based**

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 USEPA National Drinking Water Regulations Maximum Contaminant Levels
http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf

3 CT DPH Action Level List for Private Wells February 2013
http://www.ct.gov/dph/lib/dph/environmental_health/eoha/pdf/pw_action_levels.pdf

4 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

5 This criterion applies to all forms of Chlordane including alpha and gamma

6 This criterion applies to all forms of DDT including DDD and DDE

7 This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate

8 This criterion applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone

9 Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).

10 PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA)

Table 6: Surface Water Protection Criteria

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Bioconcentration Factor[2]	CT Water Quality Standards[3] Human Health Water Quality Criteria (Fish Consumption) ug/l	Calculated Human Health Fish Consumption Risk-based Water Quality Value ug/l	Recommended Human Health Water Quality Criteria ug/L	Basis for Recommended Human Health Water Quality Criteria	Aquatic Life Chronic Water Quality Criteria ug/l	Basis for Aquatic Life Water Quality Criteria	Ceiling Value ug/l	2015 Analytical Reporting Limit ug/l	Recommended Surface Water Protection Criteria ug/l	Basis for Recmomended Surface Water Protection Criteria
83329	Acenaphthene	Semivolatile Organic Substance				6.1		6.10	CT Water Quality Standards	15	Ohio GLI[4]	10,000	0.1	**150**	**Risk-based Aquatic Life**
67641	Acetone	Volatile Organic Substance	0.9	RfD oral	1.25		2,880,000	2,880,000	Risk-based	1,700	Indiana GLI	10,000	10	**10,000**	**Ceiling Value**
75058	Acetonitrile	Volatile Organic Substance	0.005	RfD oral	1.25		16,000	16,000	Risk-based	8,190	CT Tier 2	10,000	10	**10,000**	**Ceiling Value**
107028	Acrolein	Volatile Organic Substance				9		9.00	CT Water Quality Standards	3	CT Water Quality Standards	10,000	0.1	**30**	**Risk-based Aquatic Life**
15972608	Alachlor	Pesticide								44.83	Wisconsin GLI	10,000	0.1	**450**	**Risk-based Aquatic Life**
116063	Aldicarb	Pesticide								0.94	CT Tier 2	10,000	0.1	**9.4**	**Risk-based Aquatic Life**
309002	Aldrin	Pesticide				0.00005		0.00005	CT Water Quality Standards	0.035	Indiana GLI	10,000	0.05	**0.05**	**Analytical Adjustment**
	Aliphatic Hydrocarbons C_5-C_8	Volatile Organic Substance	0.04	RfD oral						20	CTDEEP 2012	10,000	100	**200**	**CTDEEP 2012[4]**
	Aliphatic Hydrocarbons C_9-C_{12}	Volatile Organic Substance	0.1	RfD oral						77	CTDEEP 2012	10,000	100	**770**	**CTDEEP 2012[4]**
	Aliphatic Hydrocarbons C_9-C_{18}	Volatile Organic Substance	0.1	RfD oral						77	CTDEEP 2012	10,000	100	**770**	**CTDEEP 2012[4]**
	Aliphatic Hydrocarbons C_{19}-C_{36}	Semivolatile Organic Substance	2	RfD oral						53	CTDEEP 2012[5]	10,000	100	**530**	**CTDEEP 2012[4]**
7429905	Aluminum	Inorganic Substance	1	RfD oral	1.25		3,200,000	3,200,000	Risk-based	87	CT Water Quality Standards	10,000	20	**870**	**Risk-based Aquatic Life**
7664417	Ammonia [6]	Inorganic Substance	0.1	RfD oral	1.25		320,000	320,000	Risk-based	3,010	CT Water Quality Standards	10,000	20	**10,000**	**Ceiling Value**
62533	Aniline	Semivolatile Organic Substance	0.0057	CSF oral	1.25		561	561	Risk-based	4.1	Ohio GLI	10,000	5	**41**	**Risk-based Aquatic Life**
	Aromatic Hydrocarbons C_9-C_{10}	Volatile Organic Substance								20	CTDEEP 2012	10,000	100	**200**	**CTDEEP 2012**
	Aromatic Hydrocarbons C_{11}-C_{22}	Volatile Organic Substance								4.7	CTDEEP 2012	10,000	100	**100**	**CTDEEP 2012**
1942249	Atrazine									12	Indiana GLI	10,000		**16**	**Risk-based Aquatic Life**
7440393	Barium	Inorganic Substance	0.2	RfD oral	1.25		640,000	640,000	Risk-based	220	Ohio GLI	10,000	10	**2,200**	**Risk-based Aquatic Life**
92875	Benzidine	Semivolatile Organic Substance				0.0002		0.0002	CT Water Quality Standards	3	Michigan GLI	10,000	5	**5.0**	**Analytical Adjustment**
191242	Benzo(g,h,i)perylene	Semivolatile Organic Substance				4.92		4.92	CT Water Quality Standards			10,000	0.1	**150**	**Risk-based Human Health**
65850	Benzoic Acid	Semivolatile Organic Substance	4	RfD oral	1.25		12,800,000	12,800,000	Risk-based	901	CT Tier 2	10,000	5	**9,000**	**Risk-based Aquatic Life**
111911	Bis(2-chloroethoxy)methane	Semivolatile Organic Substance	0.003	RfD oral	0.64		18,750	18,750	Risk-based			10,000	5	**10,000**	**Ceiling Value**
7440428	Boron	Inorganic Substance	0.2	RfD oral	1.25		640,000	640,000	Risk-based	7,200	Michigan GLI	10,000	50	**10,000**	**Ceiling Value**
75274	Bromodichloromethane	Volatile Organic Substance				17		17	CT Water Quality Standards	340	Ohio GLI	10,000	0.5	**510**	**Risk-based Human Health**
74839	Bromomethane	Volatile Organic Substance	0.0005	RfD oral	3.75		533	533	Risk-based	16	Ohio GLI	10,000	0.5	**160**	**Risk-based Aquatic Life**
78933	Butanone,2- (MEK)	Volatile Organic Substance	0.6	RfD oral	1.25		1,920,000	1,920,000	Risk-based	22,000	Oho GLI	10,000	5	**10,000**	**Ceiling Value**
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD oral	185.72		1,077	1,077	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD oral	260.13		769	769	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD oral	115.07		1,738	1,738	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
85687	Butylbenzyl phthlate	Semivolatile Organic Substance				1900		1,900	CT Water Quality Standards	23	Ohio GLI	10,000	5	**230**	**Risk-based Aquatic Life**
86748	Carbazole	Semivolatile Organic Substance	0.02	CSF oral	57.63		3.5	3.5	Risk-based	5.3	CT Tier 2	10,000	5	**53**	**Risk-based Aquatic Life**
75150	Carbon disulfide	Volatile Organic Substance	0.1	RfD oral	2.48		161,290	161,290	Risk-based	15	Ohio GLI	10,000	0.5	**150**	**Risk-based Aquatic Life**

Table 6: Surface Water Protection Criteria

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Bioconcentration Factor[2]	CT Water Quality Standards[3] Human Health Water Quality Criteria (Fish Consumption) ug/l	Calculated Human Health Fish Consumption Risk-based Water Quality Value ug/l	Recommended Human Health Water Quality Criteria ug/L	Basis for Recommended Human Health Water Quality Criteria	Aquatic Life Chronic Water Quality Criteria ug/l	Basis for Aquatic Life Water Quality Criteria	Ceiling Value ug/l	2015 Analytical Reporting Limit ug/l	Recommended Surface Water Protection Criteria ug/l	Basis for Recmomended Surface Water Protection Criteria
57749	Chlordane (total)[7]	Pesticide								0.0043	CT Water Quality Standards	10,000		**0.3**	**1996 RSRs**
7773526	Chloride	Inorganic Substance								230,000	CT Water Quality Standards	10,000	2000	**10,000**	**Ceiling Value**
7782505	Chlorine	Inorganic Substance	0.1	RfD oral	1.25		320,000	320,000	Risk-based	11	CT Water Quality Standards	10,000	20	**110**	**Risk-based Aquatic Life**
106478	Chloroaniline, 4-	Semivolatile Organic Substance	0.2	CSF oral	2.02		9.9	9.9	Risk-based	0.99	CT Tier 2	10,000	5	**9.9**	**Risk-based Aquatic Life**
75003	Chloroethane	Volatile Organic Substance	0.0047	CSF Oral	0.99		860	860	Risk-based	1,100	Michigan GLI	10,000	0.5	**10,000**	**Ceiling Value**
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD oral	3.75		2,773	2,773	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD oral	202		1,584	1,584	Risk-based			10,000	5	**10,000**	**Ceiling Value**
95578	Chlorophenol, 2-	Semivolatile Organic Substance				150		150	CT Water Quality Standards	41.75	CT Tier 2	10,000	5	**420**	**Risk-based Aquatic Life**
7005723	Chlorophenol, 3-methyl-4	Semivolatile Organic Substance	0.1	RfD oral	19.2		20,833	20,833	Risk-based	7.3	CT Tier 2	10,000	5	**73**	**Risk-based Aquatic Life**
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.02	RfD oral	33.86		2,363	2,363	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.02	RfD oral	73.13		1,094	1,094	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
218019	Chrysene	Semivolatile Organic Substance				0.018		0.018	CT Water Quality Standards	4.7	Ohio GLI	10,000	0.1	**0.54**	**Risk-based Human Health**
7440484	Cobalt	Inorganic Substance	0.0003	RfD oral	1.25		960	960	Risk-based	24	Ohio GLI	10,000	1	**240**	**Risk-based Aquatic Life**
110827	Cyclohexane	Volatile Organic Substance	1.7	RfD oral	35.08		193,843	193,843	Risk-based	276	CT Tier 2	10,000	0.5	**2,800**	**Risk-based Aquatic Life**
94757	D, 2,4-	Pesticide	0.21	RfD oral	13		64,615	64,615	Risk-based	172	Wisconsin GLI	10,000	0.05	**1,700**	**Risk-based Aquatic Life**
53703	Dibenzo(a,h)anthracene	Semivolatile Organic Substance				0.01		0.01	CT Water Quality Standards			10,000	0.1	**0.30**	**Risk-based Human Health**
132649	Dibenzofuran	Volatile Organic Substance	0.001	RfD oral	117.16		34	34	Risk-based	4	Ohio GLI	10,000	0.5	**40**	**Risk-based Aquatic Life**
96128	Dibromo-3-chloropropane, 1,2-	Semivolatile Organic Substance	7	CSF oral	14.98		0.04	0.04	Risk-based			10,000	0.05	**1.1**	**Risk-based Human Health**
1918009	Dicamba	Pesticide	0.03	RfD oral	1.25		96,000	96,000	Risk-based	216.58	Wisconsin GLI	10,000	0.03	**2,200**	**Risk-based Aquatic Life**
91941	Dichlorobenzidine, 3,3'-	Semivolatile Organic Substance				0.028		0.03	CT Water Quality Standards	4.5	CT Tier 2	10,000	5	**5.0**	**Analytical Adjustment**
75718	Dichlorodiflouromethane	Volatile Organic Substance	0.05	RfD oral	3.63		55,096	55,096	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
50293	Dichlorodiphenyl Trichloroethane, P, P'- (DDT)[8]	Pesticide				0.00022		0.00022	CT Water Quality Standards	0.001	CT Water Quality Standards	10,000	0.05	**0.05**	**Analytical Adjustment**
75343	Dichloroethane 1,1	Volatile Organic Substance	0.0057	CSF oral	1.88		373	373	Risk-based	410	Ohio GLI	10,000	0.5	**4,100**	**Risk-based Aquatic Life**
107062	Dichloroeth**ene**, 1,2-	Volatile Organic Substance	0.0067	RfD oral	1.2		22,333	22,333	Risk-based	970	Ohio GLI	10,000	0.5	**9,700**	**Risk-based Aquatic Life**
156592	Dichloroethylene, cis 1,2-	Volatile Organic Substance	0.002	RfD oral	4.7		1,702	1,702	Risk-based	620	Indiana GLI	10,000	0.5	**6,200**	**Risk-based Aquatic Life**
156605	Dichloroethylene, trans 1,2-	Volatile Organic Substance				10,000		10,000	CT Water Quality Standards			10,000	0.5	**10,000**	**Ceiling Value**
120365	Dichloroprop	Pesticide	0.0036	RfD oral	1.25		11,520	11,520	Risk-based	12	CT Tier 2	10,000	0.5	**120**	**Risk-based Aquatic Life**
78875	Dichloropropane 1,2	Volatile Organic Substance				15		15	CT Water Quality Standards	520	Ohio GLI	10,000	0.5	**150**	**Risk-based Human Health**
84662	Diethyl phthalate	Semivolatile Organic Substance				44,000		44,000	CT Water Quality Standards	220	Ohio GLI	10,000	5	**2,200**	**Risk-based Aquatic Life**
131113	Dimethyl phthalate	Semivolatile Organic Substance				1,100,000		1,100,000	CT Water Quality Standards	1,100	Ohio GLI	10,000	5	**10,000**	**Ceiling Value**
105679	Dimethylphenol, 2,4-	Semivolatile Organic Substance				850		850	CT Water Quality Standards	15	Ohio GLI	10,000	5	**150**	**Risk-based Aquatic Life**

Table 6: Surface Water Protection Criteria

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Bioconcentration Factor[2]	CT Water Quality Standards[3] Human Health Water Quality Criteria (Fish Consumption) ug/l	Calculated Human Health Fish Consumption Risk-based Water Quality Value ug/l	Recommended Human Health Water Quality Criteria ug/L	Basis for Recommended Human Health Water Quality Criteria	Aquatic Life Chronic Water Quality Criteria ug/l	Basis for Aquatic Life Water Quality Criteria	Ceiling Value ug/l	2015 Analytical Reporting Limit ug/l	Recommended Surface Water Protection Criteria ug/l	Basis for Recmomended Surface Water Protection Criteria
51285	Dinitrophenol, 2,4-	Semivolatile Organic Substance				5,300		5,300	CT Water Quality Standards	71	Minnestoa GLI	10,000	10	**710**	**Risk-based Aquatic Life**
534521	Dinitrophenol, 2-methyl-4,6-	Semivolatile Organic Substance				280		280	CT Water Quality Standards	0.71	CT Tier 2	10,000	10	**10**	**Analytical Adjustment**
121142	Dinitrotoluene, 2,4-	Semivolatile Organic Substance				3.4		3.4	CT Water Quality Standards	44	Ohio GLI	10,000	5	**100**	**Risk-based Human Health**
606202	Dinitrotoluene, 2,6-	Semivolatile Organic Substance	0.68	CSF oral	3.8		1.5	1.5	Risk-based	81	Ohio GLI	10,000	5	**46**	**Risk-based Human Health**
123911	Dioxane, 1,4-	Semivolatile Organic Substance	0.1	CSF oral	1.25		32	32	Risk-based			10,000	0.5	**960**	**Risk-based Human Health**
122667	Diphenylhydrazine, 1,2-	Semivolatile Organic Substance				0.2		0.2	CT Water Quality Standards	1.1	Indiana GLI	10,000	5	**6.0**	**Risk-based Human Health**
115297	Endosulfan (total)[9]	Pesticide				89		89	CT Water Quality Standards	0.056	CT Water Quality Standards	10,000	0.05	**0.56**	**Risk-based Aquatic Life**
72208	Endrin (total)[10]	Pesticide										10,000		**0.1**	**1996 RSRs**
64175	Ethanol	Semivolatile Organic Substance	0.067	RfD oral	1.25		214,400	214,400	Risk-based	2,276	CT Tier 2	10,000	1000	**10,000**	**Ceiling Value**
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD oral	1.25		2,880,000	2,880,000	Risk-based	1,597	CT Tier 2	10,000	0.5	**10,000**	**Ceiling Value**
107211	Ethylene glycol	Semivolatile Organic Substance	0.8	RfD oral	1.25		2,560,000	2,560,000	Risk-based	122,948	Wisconsin GLI	10,000	1000	**10,000**	**Ceiling Value**
	Extractable Total Petroleum Hydrocarbons	Semivolatile Organic Substance								47	CTDEEP 2012a[11]	10,000	250	**250**	**CTDEEP 2012a**
50000	Formaldehyde	Semivolatile Organic Substance	0.02	RfD oral	1.25		64,000	64,000	Risk-based	970	CT Tier 2	10,000	50	**9,700**	**Risk-based Aquatic Life**
87683	Hexachlorobutadiene	Semivolatile Organic Substance				18		18	CT Water Quality Standards	1	New York GLI	10,000	5	**10**	**Risk-based Aquatic Life**
319846	Hexachlorocyclohexane, alpha	Pesticide				0.0049		0.0049	CT Water Quality Standards	0.011	Minnesota Chippewa GLI	10,000	0.05	**0.11**	**Risk-based Aquatic Life**
319857	Hexachlorocyclohexane, beta-	Pesticide				0.017		0.017	CT Water Quality Standards	0.011	Minnesota Chippewa GLI	10,000	0.05	**0.11**	**Risk-based Aquatic Life**
319868	Hexachlorocyclohexane, delta-	Pesticide	1.8	CSF oral	250		0.009	0.009	Risk-based	0.011	Minnesota Chippewa GLI	10,000	0.05	**0.11**	**Risk-based Aquatic Life**
77474	Hexachlorocyclopentadiene	Pesticide				1100		1,100	CT Water Quality Standards	0.07	CT Tier 2	10,000	0.05	**0.70**	**Risk-based Aquatic Life**
110543	Hexane, n-	Volatile Organic Substance	0.06	RfD oral	79.3		3,026	3,026	Risk-based	20	CTDEEP 2012	10,000	0.1	**200**	**Risk-based Aquatic Life**
591786	Hexanone-2	Volatile Organic Substance	0.005	RfD oral	7		2,857	2,857	Risk-based			10,000	0.05	**10,000**	**Ceiling Value**
193395	Indeno(1,2,3-c,d)pyrene	Semivolatile Organic Substance				0.018		0.02	CT Water Quality Standards			10,000	0.1	**0.54**	**Risk-based Human Health**
7439896	Iron	Inorganic Substance								1,000	EPA[12]	10,000	40	**10,000**	**Risk-based Aquatic Life**
78591	Isophorone	Semivolatile Organic Substance				960		960	CT Water Quality Standards	920	Ohio GLI	10,000	5	**9,200**	**Risk-based Aquatic Life**
67630	Isopropanol	Semivolatile Organic Substance	0.33	RfD oral	1.25		1,056,000	1,056,000	Risk-based			10,000	200	**10,000**	**Ceiling Value**
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD oral	51.83		7,718	7,718	Risk-based	21.4	CT Tier 2	10,000	0.5	**210**	**Risk-based Aquatic Life**
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.03	RfD oral	113.05		1,061	1,061	Risk-based	20.4	CT Tier 2	10,000	0.5	**200**	**Risk-based Aquatic Life**
58899	Lindane	Pesticide				0.063		0.06	CT Water Quality Standards	0.011	Minnesota Chippewa GLI	10,000	0.05	**0.11**	**Risk-based Aquatic Life**
7439932	Lithium	Inorganic Substance	0.002	RfD oral	1.25		6,400	6,400	Risk-based	440	Michigan GLI	10,000	10	**4,400**	**Risk-based Aquatic Life**
7439965	Manganese	Inorganic Substance	0.05	RfD oral	1.25		160,000	160,000	Risk-based	93.48	Wisconsin GLI	10,000	15	**930**	**Risk-based Aquatic Life**
67561	Methanol	Semivolatile Organic Substance	2	RfD oral	1.25		6,400,000	6,400,000	Risk-based	330	Indiana GLI	10,000	1000	**3,300**	**Risk-based Aquatic Life**
72435	Methoxychlor	Pesticide	0.00002	RfD oral	4400		0.018	0.018	Risk-based	0.03	EPA	10,000	0.5	**0.50**	**Analytical Adjustment**

Table 6: Surface Water Protection Criteria

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Bioconcentration Factor[2]	CT Water Quality Standards[3] Human Health Water Quality Criteria (Fish Consumption) ug/l	Calculated Human Health Fish Consumption Risk-based Water Quality Value ug/l	Recommended Human Health Water Quality Criteria ug/L	Basis for Recommended Human Health Water Quality Criteria	Aquatic Life Chronic Water Quality Criteria ug/l	Basis for Aquatic Life Water Quality Criteria	Ceiling Value ug/l	2015 Analytical Reporting Limit ug/l	Recommended Surface Water Protection Criteria ug/l	Basis for Recmomended Surface Water Protection Criteria
80626	Methyl methacrylate	Volatile Organic Substance	0.14	RfD oral	0.91		615,385	615,385	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF oral	2.7		51	51	Risk-based	6.1	Wisconsin GLI	10,000	5	**61**	**Risk-based Aquatic Life**
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD oral	73.89		217	217	Risk-based	6.2	Wisconsin GLI	10,000	5	**62**	**Risk-based Aquatic Life**
95487	Methylphenol, 2- (Cresol, o-)	Semivolatile Organic Substance	0.02	RfD oral	2.5		32,000	32,000	Risk-based	67	Ohio GLI	10,000	5	**670**	**Risk-based Aquatic Life**
108394	Methylphenol, 3- (Cresol, m-)	Semivolatile Organic Substance	0.017	RfD oral	2.54		26,772	26,772	Risk-based	62	Ohio GLI	10,000	5	**620**	**Risk-based Aquatic Life**
106445	Methylphenol, 4- (Cresol, p-)	Semivolatile Organic Substance	0.02	RfD oral	2.46		32,520	32,520	Risk-based	55.5	CT Tier 2	10,000	5	**560**	**Risk-based Aquatic Life**
1634044	Methyl-tert butyl ether	Volatile Organic Substance	0.01	RfD oral	1.25		32,000	32,000	Risk-based	32000	Michigan GLI	10,000	0.5	**10,000**	**Ceiling Value**
91203	Napthalene	Semivolatile Organic Substance				20513		20,513	CT Water Quality Standards	21	Ohio GLI	10,000	5	**210**	**Risk-based Aquatic Life**
88744	Nitroaniline, 2-	Semivolatile Organic Substance	0.02	CSF oral	2.09		96	96	Risk-based	21	CT Tier 2	10,000	10	**210**	**Risk-based Aquatic Life**
99092	Nitroaniline, 3-	Semivolatile Organic Substance	0.02	CSF oral	0.89		225	225	Risk-based	7	CT Tier 2	10,000	10	**70**	**Risk-based Aquatic Life**
100016	Nitroaniline, 4-	Semivolatile Organic Substance	0.02	CSF oral	0.93		215	215	Risk-based	118	CT Tier 2	10,000	10	**1,200**	**Risk-based Aquatic Life**
98953	Nitrobenzene	Volatile Organic Substance				690		690	CT Water Quality Standards	230	Michigan GLI	10,000	5	**2,300**	**Risk-based Aquatic Life**
88755	Nitrophenol,2-	Semivolatile Organic Substance			2.33					56	Michigan GLI	10,000	5	**560**	**Risk-based Aquatic Life**
62759	Nitrosodimethylamine, N-	Semivolatile Organic Substance				3		3.0	CT Water Quality Standards			10,000	5	**90**	**Risk-based Human Health**
621647	Nitrosodi-n-propylamine, N-	Semivolatile Organic Substance				0.51		0.51	CT Water Quality Standards			10,000	5	**15**	**Risk-based Human Health**
86306	Nitrosodiphenylamine, N-	Semivolatile Organic Substance				6		6.0	CT Water Quality Standards	25	Indiana GLI	10,000	5	**180**	**Risk-based Human Health**
82688	Pentachloronitrobenzene	Semivolatile Organic Substance	0.001	RfD oral	294.51		14	14	Risk-based	2.5	CT Tier 2	10,000	5	**25**	**Risk-based Aquatic Life**
87865	Pentachlorophenol	Semivolatile Organic Substance				3		3.0	CT Water Quality Standards	15	CT Water Quality Standards	10,000	0.2	**30**	**Risk-based Human Health**
85018	Phenanthrene	Volatile Organic Substance				49.17		49.17	CT Water Quality Standards	1.4	Michigan GLI	10,000	0.1	**14**	**Risk-based Aquatic Life**
103651	Propylbenzene, n-	Volatile Organic Substance	0.1	RfD oral	54.67		7,317	7,317	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
57556	Propylene glycol	Semivolatile Organic Substance	20	RfD oral	1.25		64,000,000	64,000,000	Risk-based	20,624	Wisconsin GLI	10,000	1000	**10,000**	**Ceiling Value**
110861	Pyridine	Volatile Organic Substance	0.0003	RfD oral	1.25		960	960	Risk-based	26.2	CT Tier 2	10,000	5	**260**	**Risk-based Aquatic Life**
100425	Styrene	Volatile Organic Substance	0.02	RfD oral	14.72		5,435	5,435	Risk-based	32	Ohio GLI	10,000	0.5	**320**	**Risk-based Aquatic Life**
75650	Tert-butyl alcohol (Total oxygenates)[13]	Semivolatile Organic Substance	0.017	RfD oral	1.25		54,400	54,400	Risk-based	23,521	CT Tier 2	10,000	100	**10,000**	**Ceiling Value**
95943	Tetrachlorobenzene, 1,2,4,5-	Semivolatile Organic Substance	0.0003	RfD oral	1125		1.1	1.1	Risk-based	2.02	CT Tier 2	10,000	5	**11**	**Risk-based Human Health**
630206	Tetrachloroethane 1,1,1,2	Volatile Organic Substance	0.026	CSF Oral	14.2		10.8	10.8	Risk-based	85	Ohio GLI	10,000	0.5	**330**	**Risk-based Human Health**
109999	Tetrahydrofuran	Volatile Organic Substance	0.01	CSF oral	1.25		320	320	Risk-based	11000	Ohio GLI	10,000	1	**9,600**	**Risk-based Human Health**
7440315	Tin	Inorganic Substance	0.01	RfD oral	39.47		1,013	1,013	Risk-based	180	Ohio GLI	10,000	20	**1,800**	**Risk-based Aquatic Life**
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	3	RfD oral	21.36		561,798	561,798	Risk-based	32	Michigan GLI	10,000	0.5	**320**	**Risk-based Aquatic Life**
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF oral	430		0.3	0.3	Risk-based	130	Michigan GLI	10,000	0.5	**9.6**	**Risk-based Human Health**
75694	Trichlorofluoromethane	Volatile Organic Substance	0.3	RfD oral	6.99		171,674	171,674	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**

Table 6: Surface Water Protection Criteria

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Bioconcentration Factor[2]	CT Water Quality Standards[3] Human Health Water Quality Criteria (Fish Consumption) ug/l	Calculated Human Health Fish Consumption Risk-based Water Quality Value ug/l	Recommended Human Health Water Quality Criteria ug/L	Basis for Recommended Human Health Water Quality Criteria	Aquatic Life Chronic Water Quality Criteria ug/l	Basis for Aquatic Life Water Quality Criteria	Ceiling Value ug/l	2015 Analytical Reporting Limit ug/l	Recommended Surface Water Protection Criteria ug/l	Basis for Recmomended Surface Water Protection Criteria
95954	Trichlorophenol, 2,4,5-	Semivolatile Organic Substance	0.1	RfD oral	160		2,500	2,500	Risk-based	2.75	CT Tier 2	10,000	5	**28**	**Risk-based Aquatic Life**
88062	Trichlorophenol, 2,4,6-	Semivolatile Organic Substance				2.4		2.4	CT Water Quality Standards	4.9	Ohio GLI	10,000	5	**49**	**Risk-based Aquatic Life**
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.02	RfD oral	49.14		1,628	1,628	Risk-based	15	Ohio GLI	10,000	0.5	**150**	**Risk-based Aquatic Life**
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.02	RfD oral	34.65		2,309	2,309	Risk-based	26	Ohio GLI	10,000	0.5	**260**	**Risk-based Aquatic Life**
7440611	Uranium	Inorganic Substance	0.003	RfD oral	1.25		9,600	9,600	Risk-based			10,000	5	**10,000**	**Ceiling Value**
1314621	Vanadium	Inorganic Substance	0.001	RfD oral	15.31		261	261	Risk-based	27	Michigan GLI	10,000	5	**270**	**Risk-based Aquatic Life**
108054	Vinyl acetate	Volatile Organic Substance	0.057	RfD oral	1.25		182,400	182,400	Risk-based			10,000	0.5	**10,000**	**Ceiling Value**
1330207	Xylenes	Volatile Organic Substance	0.2	RfD oral	21.36		37,453	37,453	Risk-based	27	Ohio GLI	10,000	0.5	**270**	**Risk-based Aquatic Life**

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 Bioconcentration Factors obtained from supporting documentation for the EPA Nationally Recommended Water Quality Criteria or were derived using structure activity relationships based on the octanol/water partition coefficient for each chemical. Octanol/water partition coefficients were obtained from the ChemIDplus database (US National Library of Medicine available at: http://chem.sis.nlm.nih.gov/chemidplus/). Bioconcentration Factors were calculated using the BCFwin module of the USEPA Estimation Programs Interface Suite software (2007). http://www2.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface

3 CT Water Quality Standards, available at:
http://www.ct.gov/deep/lib/deep/regulations/22a/22a-426-1through9.pdf

4 Great Lakes Initiative (GLI) criteria obtained from GLI Clearinghouse in September 2015, database available at:
http://www2.epa.gov/gliclearinghouse

5 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012.
Available at:
http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

6 Ammonia criterion is calculated using pH=7.0 and temperature =25^{o}C

7 This criteron applies to all forms of Chlordane including alpha and gamma

8 This criterion applies to all forms of DDT including DDD and DDE

9 This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate

10 This critereon applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone

11 Values from Extractable Petroleum Hydrocarbon Fractions Using the ETPH Analytical Method and Criteria Development Technical Support Document , CT DEEP July 2012.
Available at:
http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_etph.pdf

12 EPA Nationally Recommended Water Quality Criteria, available at:
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

13 Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).

Table 7: Residential Target Indoor Air Concentration (TAC) Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Exposure Route Basis for Toxicity Value	Potential for Mutagenicity	Children's Sensititvity Factor	Calculated Risk-based TAC (Residential) ug/m^3	Odor Threshold in Air (ug/m^3)	Indoor Air Reference Conditions (Residential) ug/m^3	Ceiling Value ug/m^3	Recommended Target Indoor Air Concentration (Residential) ug/m^3	Basis for Recommended Target Indoor Air Concentration
83329	Acenaphthene	Semivolatile Organic Substance	0.06	RfD	Oral	Non-mutagen	1	109.50			500	110	Risk-based
75058	Acetonitrile	Volatile Organic Substance	0.0171	RfD	Inhalation	Non-mutagen	1	31.29			500	31	Risk-based
107028	Acrolein	Volatile Organic Substance	0.0000057	RfD	Inhalation	Non-mutagen	1	0.01			500	0.01	Risk-based
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance								130	500	130	CTDEEP 2012[2]
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance								115	500	115	CTDEEP 2012[2]
	Aliphatic Hydrocarbons C9-C18	Volatile Organic Substance								115	500	115	CTDEEP 2012[2]
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance								15	500	15	CTDEEP 2012[2]
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance								15	500	15	CTDEEP 2012[2]
75274	Bromodichloromethane	Volatile Organic Substance	0.1295	CSF	Inhalation	Mutagen	2	0.02		Non Detect	500	0.02	Risk-based
74839	Bromomethane	Volatile Organic Substance	0.0014	RfD	Inhalation	Non-mutagen	1	2.61		Non Detect	500	2.6	Risk-based
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD	Oral	Non-mutagen	1	91.25			500	91	Risk-based
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD	Oral	Non-mutagen	1	91.25			500	91	Risk-based
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD	Oral	Non-mutagen	1	91.25			500	91	Risk-based
75150	Carbon disulfide	Volatile Organic Substance	0.20	RfD	Inhalation	Non-mutagen	1	365.00	110		500	110	Odor Threshold
75003	Chloroethane	Volatile Organic Substance	0.0046	CSF	Inhalation	Non-mutagen	1	0.94			500	0.9	Risk-based
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD	Inhalation	Non-mutagen	1	4.69			500	4.7	Risk-based
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD	Oral	Non-mutagen	1	146.00			500	150	Risk-based
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.023	RfD	Inhalation	Non-mutagen	1	41.71	320		500	42	Risk-based
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.023	RfD	Inhalation	Non-mutagen	1	41.71	320		500	42	Risk-based
110827	Cyclohexane	Volatile Organic Substance	1.714	RfD	Inhalation	Non-mutagen	1	3128.57			500	500	Ceiling Value
72559	Dibenzofuran	Volatile Organic Substance	0.001	RfD	Oral	Non-mutagen	1	1.83			500	1.8	Risk-based
96129	Dichlorobutene, 1,4-	Volatile Organic Substance	14.70	CSF	Inhalation	Non-mutagen	1	0.0003			500	0.0003	Risk-based
1918009	Dichlorodiflouromethane	Volatile Organic Substance	0.029	RfD	Inhalation	Non-mutagen	1	52.14			500	52	Risk-based
540590	Dichloroethene, 1,2-	Volatile Organic Substance	0.0067	RfD	Oral	Non-mutagen	1	12.23			500	12	Risk-based
123911	Dioxane, 1,4-		0.0175	CSF	Inhalation	Non-mutagen	1	0.24			500	0.24	Risk-based
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD	Oral	Non-mutagen	1	1642.50			500	500	Ceiling Value
	Extractable Petroleum Hydrocarbons												CTDEEP 2012a[3]
110543	Hexane, n-	Volatile Organic Substance	0.20	RfD	Inhalation	Non-mutagen	1	365.00			500	370	Risk-based
591786	Hexanone	Volatile Organic Substance	0.0086	RfD	Inhalation	Non-mutagen	1	15.64			500	16	Risk-based
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD	Oral	Non-mutagen	1	182.50	39		500	39	Odor Threshold
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.030	RfD	Oral	Non-mutagen	1	54.75	39		500	39	Odor Threshold
80626	Methyl methacrylate	Volatile Organic Substance	0.020	RfD	Inhalation	Non-mutagen	1	36.50			500	37	Risk-based
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF	Oral	Non-mutagen	1	0.15			500	0.15	Risk-based
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD	Oral	Non-mutagen	1	7.30			500	7	Risk-based
98953	Nitrobenzene	Volatile Organic Substance	0.14	CSF	Inhalation	Non-mutagen	1	0.03			500	0.03	Risk-based

Table 7: Residential Target Indoor Air Concentration (TAC) Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Exposure Route Basis for Toxicity Value	Potential for Mutagenicity	Children's Sensititvity Factor	Calculated Risk-based TAC (Residential) ug/m^3	Odor Threshold in Air (ug/m^3)	Indoor Air Reference Conditions (Residential) ug/m^3	Ceiling Value ug/m^3	Recommended Target Indoor Air Concentration (Residential) ug/m^3	Basis for Recommended Target Indoor Air Concentration
103651	Propylbenzene, n-	Volatile Organic Substance	0.286	RfD	Inhalation	Non-mutagen	1	521.43	48		500	48	Odor Threshold
110861	Pyridine	Volatile Organic Substance	0.0003	RfD	Oral	Non-mutagen	1	0.55	170		500	0.55	Risk-based
109999	Tetrahydrofuran	Volatile Organic Substance	0.0105	CSF	Inhalation	Non-mutagen	1	0.41			500	0.41	Risk-based
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Volatile Organic Substance	3.00	RfD	Inhalation	Non-mutagen	1	5475.00			500	500	Ceiling Value
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF	oral	Non-mutagen	1	0.15		Non Detect	500	0.15	Risk-based
75694	Trichlorofluoromethane	Volatile Organic Substance	0.200	RfD	Inhalation	Non-mutagen	1	365.00			500	370	Risk-based
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.014	RfD	Inhalation	Non-mutagen	1	26.07			500	26	Risk-based
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.014	RfD	Inhalation	Non-mutagen	1	26.07			500	26	Risk-based
108054	Vinyl acetate	Volatile Organic Substance	0.006	RfD	Inhalation	Non-mutagen	1	10.43	500		500	10	Risk-based

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

3 Values from Extractable Petroleum Hydrocarbon Fractions Using the ETPH Analytical Method and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_etph.pdf

Table 8: Industrial/Commercial Target Indoor Air Concentration (TAC) Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Exposure Route Basis for Toxicity Value	Calculated Risk-based TAC (Industrial / Commercial) ug/m^3	Odor Threshold in Air (ug/m^3)	Indoor Air Reference Conditions (Industrial / Commercial) ug/m^3	Ceiling Value ug/m^3	Recommended Target Indoor Air Concentration (Industrial / Commercial) ug/m^3	Basis for Recommended Target Indoor Air Concentration
83329	Acenaphthene	Semivolatile Organic Substance	0.06	RfD	Oral	613.20			500	500	Ceiling Value
75058	Acetonitrile	Volatile Organic Substance	0.0171	RfD	Inhalation	175.20			500	180	Risk-based
107028	Acrolein	Volatile Organic Substance	0.0000057	RfD	Inhalation	0.058			500	0.06	Risk-based
	Aliphatic Hydrocarbons C5-C8	Volatile Organic Substance						330	500	330	CTDEEP 2012[2]
	Aliphatic Hydrocarbons C9-C12	Volatile Organic Substance						300	500	300	CTDEEP 2012[2]
	Aliphatic Hydrocarbons C9-C18	Volatile Organic Substance						300	500	300	CTDEEP 2012[2]
	Aromatic Hydrocarbons C11-C22	Volatile Organic Substance						45	500	45	CTDEEP 2012[2]
	Aromatic Hydrocarbons C9-C10	Volatile Organic Substance						45	500	45	CTDEEP 2012[2]
75274	Bromodichloromethane	Volatile Organic Substance	0.1295	CSF	Inhalation	0.22		Non Detect	500	0.22	Risk-based
74839	Bromomethane	Volatile Organic Substance	0.0014	RfD	Inhalation	14.60		0.60	500	15	Risk-based
104518	Butylbenzene, n-	Volatile Organic Substance	0.05	RfD	Oral	511.00			500	500	Ceiling Value
135988	Butylbenzene, sec-	Volatile Organic Substance	0.05	RfD	Oral	511.00			500	500	Ceiling Value
98066	Butylbenzene, t-	Volatile Organic Substance	0.05	RfD	Oral	511.00			500	500	Ceiling Value
75150	Carbon disulfide	Volatile Organic Substance	0.20	RfD	Inhalation	2044.00	110		500	110	Odor Threshold
75003	Chloroethane	Volatile Organic Substance	0.0046	CSF	Inhalation	6.29			500	6.3	Risk-based
74873	Chloromethane	Volatile Organic Substance	0.0026	RfD	Inhalation	26.28			500	26	Risk-based
91587	Chloronapthalene, 2-	Volatile Organic Substance	0.08	RfD	Oral	817.60			500	500	Ceiling Value
95498	Chlorotoluene, 2-	Volatile Organic Substance	0.023	RfD	Inhalation	233.60	320		500	230	Risk-based
106434	Chlorotoluene, 4-	Volatile Organic Substance	0.023	RfD	Inhalation	233.60	320		500	230	Risk-based
110827	Cyclohexane	Volatile Organic Substance	1.714	RfD	Inhalation	17520.00			500	500	Ceiling Value
72559	Dibenzofuran	Volatile Organic Substance	0.001	RfD	Oral	10.22			500	10	Risk-based

Table 8: Industrial/Commercial Target Indoor Air Concentration (TAC) Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Exposure Route Basis for Toxicity Value	Calculated Risk-based TAC (Industrial / Commercial) ug/m^3	Odor Threshold in Air (ug/m^3)	Indoor Air Reference Conditions (Industrial / Commercial) ug/m^3	Ceiling Value ug/m^3	Recommended Target Indoor Air Concentration (Industrial / Commercial) ug/m^3	Basis for Recommended Target Indoor Air Concentration
96128	Dichlorobutene, 1,4-	Volatile Organic Substance	14.70	CSF	Inhalation	0.00195			500	0.002	Risk-based
1918009	Dichlorodiflouromethane	Volatile Organic Substance	0.029	RfD	Inhalation	292.00			500	290	Risk-based
540590	Dichloroethene, 1,2-	Volatile Organic Substance	0.0067	RfD	Oral	68.47			500	68	Risk-based
123911	Dioxane, 1,4-	Semivolatile Organic Substance	0.0175	CSF	Inhalation	1.635			500	1.6	Risk-based
141786	Ethyl acetate	Volatile Organic Substance	0.9	RfD	Oral	9198.00			500	500	Ceiling Value
	Extractable Petroleum Hydrocarbons	Semivolatile Organic Substance									CTDEEP 2012a[3]
110543	Hexane, n-	Volatile Organic Substance	0.20	RfD	Inhalation	2044.00			500	500	Ceiling Value
591786	Hexanone	Volatile Organic Substance	0.0086	RfD	Inhalation	87.60			500	88	Risk-based
98828	Isopropylbenzene (cumene)	Volatile Organic Substance	0.1	RfD	Oral	1022.00	39		500	39	Odor Threshold
99876	Isopropyltoluene, 4- (cymene)	Volatile Organic Substance	0.030	RfD	Oral	306.60	39		500	39	Odor Threshold
80626	Methyl methacrylate	Volatile Organic Substance	0.020	RfD	Inhalation	204.40			500	200	Risk-based
90120	Methylnaphthalene, 1-	Volatile Organic Substance	0.029	CSF	Oral	0.987			500	0.99	Risk-based
91576	Methylnaphthalene, 2-	Volatile Organic Substance	0.004	RfD	Oral	40.88			500	41	Risk-based
98953	Nitrobenzene	Volatile Organic Substance	0.14	CSF	Inhalation	0.204			500	0.20	Risk-based
103651	Propylbenzene, n-	Volatile Organic Substance	0.286	RfD	Inhalation	2920.00	48		500	48	Odor Threshold
110861	Pyridine	Volatile Organic Substance	0.0003	RfD	Oral	3.07	170		500	3.1	Risk-based
109999	Tetrahydrofuran	Volatile Organic Substance	0.0105	CSF	Inhalation	2.73			500	2.7	Risk-based
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2	Volatile Organic Substance	3.00	RfD	Inhalation	30660.00			500	500	Ceiling Value
120821	Trichlorobenzene, 1,2,4-	Volatile Organic Substance	0.029	CSF	Oral	0.987		3	500	3.4	Reference Conditions
75694	Trichlorofluoromethane	Volatile Organic Substance	0.200	RfD	Inhalation	2044.00			500	500	Ceiling Value
95636	Trimethylbenzene, 1,2,4-	Volatile Organic Substance	0.014	RfD	Inhalation	146.00			500	150	Risk-based

Table 8: Industrial/Commercial Target Indoor Air Concentration (TAC) Calculation Table

CASRN	Substance	Type of Chemical	Recommended Toxicity Value	Type of Toxicity Value[1]	Exposure Route Basis for Toxicity Value	Calculated Risk-based TAC (Industrial / Commercial) ug/m^3	Odor Threshold in Air (ug/m^3)	Indoor Air Reference Conditions (Industrial / Commercial) ug/m^3	Ceiling Value ug/m^3	Recommended Target Indoor Air Concentration (Industrial / Commercial) ug/m^3	Basis for Recommended Target Indoor Air Concentration
108678	Trimethylbenzene, 1,3,5-	Volatile Organic Substance	0.014	RfD	Inhalation	146.00			500	150	Risk-based
108054	Vinyl acetate	Volatile Organic Substance	0.006	RfD	Inhalation	58.40	500		500	58	Risk-based

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was applied.

Footnotes:

1 RfD Oral:
These values are Reference Doses (mg/kg/day) for non-carcinogenic substances

CSF Oral:
These values are Cancer Slope Factors (1/(mg/kg/day)) for carcinogenic substances

2 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

3 Values from Extractable Petroleum Hydrocarbon Fractions Using the ETPH Analytical Method and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_etph.pdf

Table 9: Volatilization Criteria Calculation Table[1]

CASRN	Substance	Physical Constants[2]		Recommended Soil Vapor Volatilization Criteria				Recommended Groundwater Volatilization Criteria	
		Henry's Law Constant atm m^3 / mol	Molecular Weight g/mole	mg/m^3 Residential	mg/m^3 Industrial Commercial	ppm Residential	ppm Industrial Commercial	ug/L Residential	ug/L Industrial Commercial
83329	Acenaphthene	0.000184	154.211	83	690	13	109	30,500	50,000
75058	Acetonitrile	0.0000345	41.0527	24	240	14	140	37,100	50,000
107028	Acrolein	0.000122	56.0636	0.008	0.081	0.003	0.035	4.0	50
	Aliphatic Hydrocarbons C5-C8[3]			100	460	25	120	100	215
	Aliphatic Hydrocarbons C9-C12[3]			90	415	15	70	100	160
	Aliphatic Hydrocarbons C9-C18[3]							100	155
	Aromatic Hydrocarbons C11-C22[3]							1,710	12,000
	Aromatic Hydrocarbons C9-C10[3]			10	60	2.00	15	450	3,300
75274	Bromodichloromethane	0.00212	163.829	0.012	0.31	0.002	0.046	1.1	35
74839	Bromomethane	0.00734	94.9387	2	20	0.51	5.2	83	1,100
104518	Butylbenzene, n-	0.0159	134.221	69	690	13	130	1600	21,800
135988	Butylbenzene, sec-	0.0176	134.221	69	690	13	130	1500	20,100
98066	Butylbenzene, t-	0.0132	134.221	69	690	13	130	1900	25,300
75150	Carbon disulfide	0.0144	76.143	83	150	27	48	2100	5,200
75003	Chloroethane	0.0111	64.5145	0.71	8.7	0.27	3.3	22	360
74873	Chloromethane	0.00882	50.4877	3.6	36	1.70	18	130	1,800
91587	Chloronapthalene, 2-	0.00032	162.618	110	690	17	100	27,300	50,000
95498	Chlorotoluene, 2-	0.00357	126.585	32	320	6.1	62	2,100	28,300
106434	Chlorotoluene, 4-	0.00438	126.585	32	320	6.1	62	1,900	25,200

Table 9: Volatilization Criteria Calculation Table[1]

CASRN	Substance	Physical Constants[2]		Recommended Soil Vapor Volatilization Criteria				Recommended Groundwater Volatilization Criteria	
		Henry's Law Constant atm m^3 / mol	Molecular Weight g/mole	mg/m^3 Residential	mg/m^3 Industrial Commercial	ppm Residential	ppm Industrial Commercial	ug/L Residential	ug/L Industrial Commercial
110827	Cyclohexane	0.15	84.1608	380	690	110	200	1,100	2,800
72559	Dibenzofuran	0.000213	168.194	1.4	14	0.20	2.1	460	5,800
96129	Dichlorobutene, 1,4-	0.033	125	0.0026	0.0027	0.0005	0.0005	0.5	0.5
1918009	Dichlorodiflouromethane	0.343	120.913	39	400	8.0	81	53	720
540590	Dichloroethene, 1,2-	0.00408	96.9438	9.30	95	2.3	24	570	7,700
123911	Dioxane, 1,4-	0.0000048	88.1052	0.18	2.2	0.050	0.61		
141786	Ethyl acetate	0.000134	88.1052	380	690	100	190	50,000	50,000
	Extractable Petroleum Hydrocarbons[4]							250	250
110543	Hexane, n-	1.8	86.1766	280	690	79	200	71	240
591786	Hexanone,2-	0.0000932	100.16	12	120	2.90	29	7,600	94,000
98828	Isopropylbenzene (cumene)	0.0115	120.194	30	54	6.0	11	900	2,200
99876	Isopropyltoluene, 4- (cymene)	0.012	136.24	30	54	5.3	9.7	870	2,100
80626	Methyl methacrylate	0.000319	100.116	28	280	6.8	68	6,800	87,600
90120	Methylnaphthalene,1-	0.000514	142.2	0.11	1.4	0.019	0.24	20	320
91576	Methylnaphthalene, 2-	0.000518	142.2	5.5	57	0.95	9.7	1,000	13,100
98953	Nitrobenzene	0.000024	123.11	0.023	0.28	0.005	0.056	51	750
103651	Propylbenzene, n-	0.0105	120.194	36	67	7.4	14	1,200	2,900
110861	Pyridine	0.000011	79.1015	0.41	4.2	0.13	1.3	1,900	23,500
109999	Tetrahydrofuran	0.0000705	72.1062	0.31	3.8	0.10	1.28	250	3,700

Table 9: Volatilization Criteria Calculation Table[1]

CASRN	Substance	Physical Constants[2]		Recommended Soil Vapor Volatilization Criteria				Recommended Groundwater Volatilization Criteria	
		Henry's Law Constant atm m^3 / mol	Molecular Weight g/mole	mg/m^3 Residential	mg/m^3 Industrial Commercial	ppm Residential	ppm Industrial Commercial	ug/L Residential	ug/L Industrial Commercial
76131	Trichloro-1,2,2-trifluoroethane, 1,1,2-	0.526	187.375	380	690	50	90	330	810
120821	Trichlorobenzene, 1,2,4-	0.00142	181.449	0.11	4.7	0.015	0.64	12	660
75694	Trichlorofluoromethane	0.097	137.368	280	690	50	120	1,300	4,300
95636	Trimethylbenzene, 1,2,4-	0.00616	120.194	20	200	4.0	41	940	12,800
108678	Trimethylbenzene, 1,3,5-	0.00877	120.194	20	200	4.0	41	730	10,000
108054	Vinyl acetate	0.000511	86.0894	7.9	81	2.2	23	1,500	18,900

The risk-based recommended criteria presented above are adjusted to 2 significant digits, though values greater than 10,000 are adjusted to 3 significant digits, and rounding was

Footnotes:

1 All recommended volatilization criteria are derived from the recommended Target Indoor Air Concentrations except for the Residential Soil Vapor Criteria and the Residential and Industrial/Commercial Groundwater Volatilization Criteria for 1,4 dichlorobutene, which are based on analytic achievability.

2 Values from ChemIDplus, U.S. National Library of Medicine, available http://chem.sis.nlm.nih.gov/chemidplus/

3 Values from Petroleum Hydrocarbons Using the EPH/VPH/APH Analytical Methods and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_ephvphaph.pdf

4 Values from Extractable Petroleum Hydrocarbon Fractions Using the ETPH Analytical Method and Criteria Development Technical Support Document , CT DEEP July 2012. Available at:

http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/technical_support_document_etph.pdf

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Acenaphthene	1,000	2,500	8.4	84	420	150	83	690	13	110	30,500	50,000
Acetone	RSR[1]	RSR	RSR	RSR	RSR	10,000			RSR	RSR	RSR	RSR
Acetonitrile	340	1,000	0.70	7.0	35	10,000	24	240	14	140	37,100	50,000
Acrolein	34	1,000	0.20	2.0	10	30	0.008	0.081	0.003	0.035	4.0	50
Alachlor	RSR	RSR	RSR	RSR	RSR	450						
Aldicarb	RSR	RSR	RSR	RSR	RSR	9.4						
Aldrin	0.04	0.34	0.002	0.01	0.05	0.05						
Aliphatic Hydrocarbons C5-C8	500	1,000	6	55	280	200	100	460	25	120	100	215
Aliphatic Hydrocarbons C9-C12	500	1,000	15	140	700	770	90	415	15	70	100	160
Aliphatic Hydrocarbons C9-C18	500	1,000	20	140	700	770					100	155
Aliphatic Hydrocarbons C19-C36	1,000	2,500	20	200	1,000	530						
Aluminum	50,000	50,000	0.05*	0.5*	50	870						
Ammonia	6,800	50,000	0.7*	7*	700	10,000						
Aniline	110	1,000	0.20	1.2	6.1	41						
Aromatic Hydrocarbons C9-C10	500	1,000	5	20	100	200	10	60	2.00	15	450	3,300
Aromatic Hydrocarbons C11-C22	500	1,000	20	30	140	100					1,710	12,000

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Atrazine	RSR	RSR	RSR	RSR	RSR	16						
Barium	RSR	RSR	RSR	RSR	RSR	2,200						
Benzidine	0.20	0.20	0.20	1.0	5.0	5.0						
Benzo(g,h,i)perylene	8.4	78	1	1	0.48	150						
Benzoic Acid	1,000	2,500	20	200	1,000	9,000						
Bis(2-chloroethoxy)methane	200	2,500	0.42	4.2	21	10,000						
Boron	13,500	50,000	1.0*	10*	1,000	10,000						
Bromodichloromethane	18	170	0.02	0.21	1.0	510	0.012	0.31	0.002	0.046	1.1	35
Bromomethane	34	1,000	0.07	0.70	3.5	160	2	20	0.51	5.2	83	1,100
Butanone,2- (MEK)	RSR	RSR	RSR	RSR	RSR	10,000						
Butylbenzene, n-	500	1,000	7.0	70	350	10,000	69	690	13	130	1600	21,800
Butylbenzene, sec-	500	1,000	7.0	70	350	10,000	69	690	13	130	1,500	20,100
Butylbenzene, t-	500	1,000	7.0	70	350	10,000	69	690	13	130	1,900	25,300
Butylbenzyl phthlate	RSR	RSR	RSR	RSR	RSR	230						
Carbazole	31	290	0.20	1.0	5.0	53						
Carbon disulfide	500	1,000	0.80	8.0	40	150	83	150	27	48	2,100	5,200

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Chlordane (Total)[2]	0.49	2.2	0.066	0.066	0.30	0.3						
Chloride						10,000						
Chlorine	6,800	50,000	4.0*	40*	4,000	110						
Chloroaniline, 4-	3.1	29	0.20	1.0	5.0	9.9						
Chloroethane	130	1,000	0.15	1.5	7.4	10,000	0.71	8.7	0.27	3.3	22	360
Chloromethane	180	1,000	0.36	3.6	18	10,000	3.6	36	1.7	18	130	1,800
Chloronapthalene, 2-	500	1,000	11	110	560	10,000	110	690	17	100	27,300	50,000
Chlorophenol, 2-	RSR	RSR	RSR	RSR	RSR	420						
Chlorophenol, 3-methyl-4	1,000	2,500	14	140	700	73						
Chlorotoluene, 2-	500	1,000	2.8	28	140	10,000	32	320	6.1	62	2,100	28,300
Chlorotoluene, 4-	500	1,000	2.8	28	140	10,000	32	320	6.1	62	1,900	25,200
Chrysene	84	780	1	1	4.8	0.54						
Cobalt	20	610	0.002*	0.02*	2.1	240						
Cyclohexane	500	1,000	20	200	1,000	2,800	380	690	110	200	1,100	2,800
D 2,4-	RSR	RSR	RSR	RSR	RSR	1,700						
Dibenzo(a,h)anthracene	1.0	1	1	1	0.10	0.30						

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Dibenzofuran	68	1,000	0.20	1.4	7.0	40	1.4	14	0.20	2.1	460	5,800
Dibromo-3-chloropropane, 1,2-	0.09	0.82	0.005	0.04	0.20	1.1						
Dicamba	500	1,000	4.2	42	210	2,200						
Dichlorobenzidine, 3,3'-	1.4	13	0.20	1.0	5.0	5.0						
Dichlorobutene, 1,4-							0.0026	0.0027	0.0005	0.0005	0.5	0.5
Dichlorodiflouromethane	500	1,000	7.0	70	350	10,000	39	400	8	82	53	720
Dichlorodiphenyl Trichloroethane, P, P'-(DDT) (Total) [3]	1.8	17	0.003	0.02	0.10	0.05						
Dichloroethane, 1,1	RSR	RSR	RSR	RSR	RSR	4,100						
Dichloroethene, 1,2-[4]						9,700	9.3	95	2.3	24	570	7,700
Dichloroethene, cis 1,2-	RSR	RSR	RSR	RSR	RSR	6,200						
Dichloroethene, trans 1,2-	RSR	RSR	RSR	RSR	RSR	10,000						
Dichloroprop	240	1,000	0.50	5.0	25	120						
Dichloropropane 1,2	RSR	RSR	RSR	RSR	RSR	150						
Diethyl phthalate	1,000	2,500	20	200	1,000	2,200						
Dimethyl phthalate	1,000	2,500	20	200	1,000	10,000						
Dimethylphenol, 2,4-	1,000	2,500	2.8	28	140	150						

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Dinitrophenol, 2,4-	140	2,500	0.30	2.8	14	710						
Dinitrophenol, 2-methyl-4,6-	20	610	0.30	2.0	10	10						
Dinitrotoluene, 2,4-	0.90	8.4	0.20	1.0	5.0	100						
Dinitrotoluene, 2,6-	0.90	8.4	0.20	1.0	5.0	46						
Dioxane, 1,4-	6.1	57	0.10	0.60	3.0	960	0.18	2.2	0.050	0.61		
Diphenylhydrazine, 1,2-	0.77	7.2	0.20	1.0	5.0	6.0						
Endosulfan (Total) [5]	41	1,000	0.084	0.84	4.2	0.56						
Endrin(Total)[6]	20	610	0.04	0.40	2.0	0.1						
Ethanol	1,000	2,500	20	200	1,000	10,000						
Ethyl acetate	500	1,000	20	200	1,000	10,000	380	690	100	190	50,000	50,000
Ethylene glycol	1,000	2,500	20	200	1,000	10,000						
Extractable Total Petroleum Hydrocarbons	RSR	RSR	RSR	RSR	RSR	250					250	250
Formaldehyde	1,000	2,500	2.8	28	140	9,700						
Hexachlorobutadiene	130	1,200	0.20	1.5	7.4	10						
Hexachlorocyclohexane, alpha	0.34	3.2	0.002	0.01	0.05	0.11						
Hexachlorocyclohexane, beta-	0.34	3.2	0.002	0.01	0.05	0.11						

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Hexachlorocyclohexane, delta-	0.34	3.2	0.002	0.01	0.05	0.11						
Hexachlorocyclopentadiene	410	1,000	0.84	8.4	42	0.70						
Hexane, n-	500	1,000	8.4	84	420	200	280	690	79	200	71	240
Hexanone-2	340	1,000	0.70	7.0	35	10,000	12	120	2.9	29	7,600	94,000
Indeno(1,2,3-c,d)pyrene	1.0	7.8	1	1	0.10	0.54						
Iron						10,000						
Isophorone	640	2,500	0.74	7.4	37	9,200						
Isopropanol	1,000	2,500	46	460	2,300	10,000						
Isopropylbenzene (cumene)	500	1,000	0.50	5.0	25	210	30	54	6.0	11	900	2,200
Isopropyltoluene, 4- (cymene)	500	1,000	0.50	5.0	25	200	30	54	5.30	9.7	870	2,100
Lindane	RSR	RSR	RSR	RSR	RSR	0.11						
Lithium	140	4,100	0.014*	0.14*	14	4,400						
Manganese	3,400	50,000	0.50*	5.0*	500	930						
Methanol	1,000	2,500	20	200	1,000	3,300						
Methoxychlor	RSR	RSR	RSR	RSR	RSR	0.50						
Methyl methacrylate	500	1,000	20	200	980	10,000	28	280	6.8	68	6,800	87,600

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Methylnaphthalene, 1-	21	200	0.20	1.0	5	61	0.11	1.4	0.019	0.24	20	320
Methylnaphthalene, 2-	270	1,000	0.56	5.6	28	62	5.5	57	0.95	9.7	1,000	13,100
Methylphenol, 2- (Cresol, o-)	1,000	2,500	2.8	28	140	670						
Methylphenol, 3- (Cresol, m-)	1,000	2,500	2.4	24	120	620						
Methylphenol, 4- (Cresol, p-)	1,000	2,500	2.8	28	140	560						
Methy-tert- butyl ether	RSR	RSR	RSR	RSR	RSR	10,000			1996 RSR	1996 RSR	1996 RSR	1996 RSR
Naphthalene	RSR	RSR	RSR	RSR	RSR	210						
Nitroaniline, 2-	31	290	0.30	2.0	10	210						
Nitroaniline, 3-	31	290	0.30	2.0	10	70						
Nitroaniline, 4-	31	290	0.30	2.0	10	1,200						
Nitrobenzene	4	41	0.20	1.0	5	2,300	0.023	0.28	0.005	0.056	51	750
Nitrophenol,2-						560						
Nitrosodimethylamine, N-	0.20	0.36	0.20	1.0	5.0	90						
Nitrosodi-n-propylamine, N-	0.20	0.82	0.20	1.0	5.0	15						
Nitrosodiphenylamine, N-	130	1,200	0.20	1.4	7.1	180						
Pentachloronitrobenzene	68	2,000	0.14	1.4	7.0	25						

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Pentachlorophenol	1996 RSR	1996 RSR	1996 RSR	1996 RSR	1996 RSR	30						
Per- and Polyfluoroalkyl Substances (PFAS)[8]	1.35	41	0.0014	0.014	0.07							
Phenanthrene	RSR	RSR	RSR	RSR	RSR	14						
Propylbenzene, n-	500	1,000	1.0	10	50	10,000	36	67	7.4	14	1,200	2,900
Propylene glycol	1,000	2,500	20	200	1,000	10,000						
Pyridine	20	610	0.20	1.0	5.0	260	0.41	4.2	0.13	1.3	1,900	23,500
Styrene	RSR	RSR	RSR	RSR	RSR	320						
Tert-butyl alcohol (Total oxygenates)[7]	1,000	2,500	2.0	20	100	10,000						
Tetrachlorobenzene, 1,2,4,5-	20	610	0.10	1.0	5.0	11						
Tetrachloroethane, 1,1,1,2	RSR	RSR	RSR	RSR	RSR	330			RSR	RSR	RSR	RSR
Tetrahydrofuran	61	570	0.08	0.80	4	9,600	0.31	3.8	0.10	1.28	250	3,700
Tin	680	20,400	0.07*	0.7*	70	1,800						
Trichloro-1,2,2-trifluoroethane, 1,1,2-	500	1,000	20	200	1,000	320	380	690	50	90	330	810
Trichlorobenzene, 1,2,4-	21	200	1.4	14	70	9.6	0.11	4.7	0.015	0.64	12	660
Trichlorofluoromethane	500	1,000	20	200	1,000	10,000	280	690	50	120	1,300	4,300
Trichlorophenol, 2,4,5-	1,000	2,500	14	140	700	28						

Table 10: CTDEEP Recommended Criteria Values for Common Additional Polluting Substances and Alternative Criteria Requests

Substance	Direct Exposure Criteria		Pollutant Mobility Criteria		Groundwater Protection Criteria	Surface Water Protection Criteria	Soil Vapor Volatilization Criteria		Soil Vapor Volatilization Criteria		Groundwater Volatilization Criteria	
	Residential	Industrial / Commercial	GA	GB			Residential	Industrial / Commercial	Residential	Industrial / Commercial	Residential	Industrial / Commercial
	mg/kg		mg/kg except if *, then mg/l by TCLP or SPLP		ug/l		mg/m^3		ppm		ug/l	
Trichlorophenol, 2,4,6-	56	520	0.20	1.0	5.0	49						
Trimethylbenzene, 1,2,4-	500	1,000	2.8	28	140	150	20	200	4.0	41	940	12,800
Trimethylbenzene, 1,3,5-	500	1,000	2.8	28	140	260	20	200	4.0	41	730	10,000
Uranium	200	6,100	0.03*	0.3*	30	10,000						
Vanadium	RSR	RSR	RSR	RSR	RSR	270						
Vinyl acetate	500	1,000	8.0	80	400	10,000	7.9	81	2.2	23	1,500	18,900
Xylene	RSR	RSR	RSR	RSR	RSR	270			RSR	RSR	RSR	RSR

Footnotes

1 CT Remediation Standard Regulations
http://www.ct.gov/deep/lib/deep/regulations/22a/22a-133k-1through3.pdf

2 This criterion applies to all forms of Chlordane including alpha and gamma

3 This criterion applies to all forms of DDT including DDD and DDE

4 Applies to mixed isomers

5 This criterion applies to all forms of Endosulfan including the I and II isomers and Endosulfan sulfate

6 This criterion applies to all forms of Endrin including Endrin Aldehyde and Endrin Ketone

7 Total Oxygenates = the sum of: Tert Butyl Alcohol (TBA), MTBE, ethyl-t-butyl ether (ETBE), t-amyl-methyl ether (TAME), diisopropyl ether (DIPE).

8 PFAS = Sum of: Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonate (PFHxS), and Perfluoroheptanoic Acid (PFHpA)