

State of Alaska
DEPARTMENT OF ENVIRONMENTAL
CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM



Procedures for Calculating Cumulative Risk
July 15, 2015

Adopted by Reference at 18 AAC 75

PROCEDURES FOR CALCULATING CUMULATIVE RISK

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1.0 INTRODUCTION

The Alaska Department of Environmental Conservation (DEC) has developed rules at 18 AAC 75, Article 3 that detail the extent of cleanup required at contaminated sites in order to adequately protect human health, safety, and welfare and the environment. Included in these rules as well as the regulations for underground storage tanks at 18 AAC 78, is the requirement for ensuring that contaminants at a site do not exceed cumulative risk thresholds for carcinogenic and noncarcinogenic compounds, accounting for exposure to multiple contaminants across multiple pathways. This document describes the procedures for calculating that cumulative risk.

Under 18 AAC 75.325(g) or 18 AAC 78.600(d), a responsible party must ensure that contaminants remaining onsite do not exceed the cumulative risk standard of 1 in 100,000 excess lifetime cancer risk across all exposure pathways for carcinogens and a hazard index of not more than one, reported to one significant figure, across all exposure pathways for noncarcinogens, regardless of whether the cleanup levels established for the site are under method two, three, or four.

ADEC utilizes a sum-of-ratios approach for calculating cumulative risk. The approach is carried out in two separate calculations; one calculation for carcinogenic effects and one for noncarcinogenic effects. Separating risk quantification in this way is necessary due to differences between the two types of effects. For carcinogens, risk is evaluated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (USEPA, 1989). Within the carcinogenic category additional adjustments are incorporated if the chemical is considered to have a mutagenic mode of action. For noncarcinogens, risks are based on exposure over a threshold that is likely to be without effects. The calculations are then incorporated into a ratio approach and summed to quantify the cumulative risk. These procedures are for cumulative risk only and do not substitute for a baseline risk assessment.

Some compounds can cause both types of effects and are included in both cumulative risk calculations. For example, aldrin causes both carcinogenic and noncarcinogenic effects from soil exposure through the human health pathway. The cleanup level in Table B1 corresponds with the carcinogenic effect because it occurs at a lower concentration than does the noncarcinogenic effect.

1.1 Carcinogens

As stated in the preceding section, carcinogenic risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogenic compound. Under 18 AAC 75.990(12), ADEC defines a carcinogen as "...a substance that meets the criteria of the descriptors "Carcinogenic to Humans" or "Likely to Be Carcinogenic to Humans" according to EPA's *Guidelines for Carcinogen Risk Assessment*, EPA/630/P-03/001F (USEPA, 2005).

Cumulative carcinogenic risk is the summation of all risks from each exposure pathway and exposure route. The cumulative carcinogenic risk equation is shown in Section 2.2. Unless demonstrated otherwise, cancer risks resulting from exposure to two or more carcinogens are assumed to be additive. The cumulative carcinogenic risk equation assumes that there are no synergistic or antagonistic chemical interactions.

1.2 Mutagens

Some of the carcinogenic compounds listed in Tables B1 and C operate by a mutagenic mode of action for carcinogenesis. Some chemicals with a mutagenic mode of action, which would be expected to cause irreversible changes to DNA, are suspected to exhibit a greater effect in early-life versus later-life exposure. Cancer risk to children in the context of EPA's cancer guidelines (USEPA, 2005) includes both early-life exposures that may result in the occurrence of cancer during childhood and early-life exposures that may contribute to cancers later in life. In keeping with this guidance, mutagenic cancer risk is calculated separately, and the mutagen vinyl chloride has a unique set of equations. However, when calculating cumulative risk, mutagens are included with carcinogens. Consult the Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, EPA/630/R-03/003F, March 2005 for further information (User's Guide, EPA Regional Screening Levels, 2015).

1.3 Noncarcinogens

Under 18 AAC 75.990(69), ADEC defines a noncarcinogen as "...a hazardous substance with adverse health effects on humans other than cancer." The noncarcinogenic risk is represented by a hazard quotient (HQ), which is calculated from the ratio of estimated intake of a chemical to the estimated intake at which there are no observed adverse effects. The hazard index (HI) is the summation of all of the HQs for all pathways and exposure routes that affect the same target organ or system endpoint.

For noncarcinogens, the health threats resulting from exposure to two or more hazardous substances with similar types of toxic response are assumed to be additive. However, many noncarcinogens have varying toxic effects and therefore assuming that these effects are additive may not be valid. Noncarcinogenic compounds affect different target organs or systems by different mechanisms of toxicity. To accurately assess the possible effects of noncarcinogenic compounds, the HI can be segregated by target organ or system endpoint and mechanism of toxicity consistent with EPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) – Interim Final* (USEPA, 1989), *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA, 1986), and *Supplemental Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (USEPA, 2000). Since the mechanism of toxicity is not well understood for many compounds, the department will evaluate segregation of the HI by target organ alone.

2.0 CALCULATING CUMULATIVE RISK

Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways via which humans are exposed. When more than one hazardous substance is present at a site or multiple exposure pathways exist, the cleanup levels in Table B1 of 18 AAC 75.341 and Table C of 18 AAC 75.345 (hereinafter "Table B1" and "Table C") may need to be adjusted downward. The cumulative cancer risk remaining at the site when cleanup is completed must not exceed 1 in 100,000 (1×10^{-5}) unless otherwise approved by ADEC, and must not exceed the cumulative noncarcinogenic risk standard at a hazard index (HI) of one, reported to one significant figure.

1. When to Perform the Cumulative Risk Analysis

The cumulative risk standard must be met upon completion of site cleanup work, but contaminant levels established during a thorough site characterization effort may be sufficient to rule out a cumulative risk, with ADEC approval. The department advises that responsible parties be cognizant early on of potential cumulative risk issues to allow adjustments to the scope of the cleanup and avoid remobilization to the site post-cleanup. The department does not require that gasoline, diesel

and residual range petroleum hydrocarbon fractions (see both Table B2 of 18 AAC 75.341 and Table C) be included in cumulative risk calculations, since selected individual compounds from the fractions are accounted for in Table B1 and Table C. However the risk may be underestimated since each fraction can consist of several other compounds not accounted for. See section 5.6 for more information.

2. Procedures

The process for calculating cumulative risk is as follows:

1. Determine whether the maximum soil concentration of each contaminant at the site exceeds $1/10^{\text{th}}$ of the human health levels in Table B1 for the applicable climate zone.¹ For groundwater, the maximum concentration is compared against $1/10^{\text{th}}$ of the cleanup levels in Table C (see Section 3.0 for addressing cumulative risk in groundwater). If no chemicals at the site exceed the $1/10^{\text{th}}$ threshold for either media, or only petroleum range contamination is present, cumulative risk does not need to be calculated for the site. For help on how to evaluate compounds not listed in ADEC tables, see Section 5.4.
2. When chemicals of potential concern (COPCs) are present, develop a conceptual site model (CSM) that shows all of the complete exposure pathways at the site. A CSM should include the source of contamination, release/transport mechanisms, contact media (i.e. soil, air, or groundwater), exposure route (i.e., dermal contact, inhalation, ingestion) and receptor (i.e. current/future resident, subsistence user, or biota). For more information on developing a CSM, refer to the department's Guidance on Developing Conceptual Site Models (ADEC, 2010).
3. Using the worksheet example in Appendix A, record the following information for each contaminant:
 - a) whether the contaminant is considered a carcinogen, noncarcinogen, or both (if it is a mutagen, record it as a carcinogen);
 - b) the exposure media (soil, groundwater, air)
 - c) exposure route (ingestion, inhalation of volatiles and/or particulates, dermal contact)
 - d) maximum concentration or the mean soil concentration at the 95th percent upper confidence limit (UCL) remaining on-site following cleanup²; and
 - e) the corresponding risk-based concentration (RBC) in Appendix B for soil or groundwater.

RBCs correspond to the concentration in soil that would cause an adverse effect through the inhalation, ingestion, or dermal contact routes of exposure. RBCs are calculated using the

¹ $1/10$ of the cleanup level corresponds to a HQ of 0.1 and cancer risk of $10\text{E-}6$.

² To employ the mean soil concentration at the 95% UCL under 18 AAC 75.380(c)(1), the department must approve an appropriate statistical method. As stated above, for groundwater, the site concentration is the maximum concentration, as described in 18 AAC 75.380(c)(2).

equations presented in ADEC's *Procedures for Calculating Cleanup Levels* (PCCL 2015) and take into account default exposure and soil/aquifer data as well as toxicological data specific to the compound of interest. The RBCs differ from Table B1 and Table C in that individual exposure pathways are shown rather than the most protective value of all the pathways as listed in the Tables. Also, some cleanup levels in Table B1 are capped at the soil saturation concentration and therefore may equate to a lifetime cancer risk or HI that is lower than the department standard.

4. For each carcinogen, risk is calculated by dividing the maximum site concentration or the mean of the 95 UCL remaining on-site by the applicable RBC and multiplying by the risk management level of 1×10^{-5} . Cumulative carcinogenic risk is the summation of all the risks from each exposure pathway and exposure route. The equation is as follows:

$$\text{Cumulative Carcinogenic Risk} = \left[\left(\frac{\text{conc}_x}{\text{RBC}_x} \right) + \left(\frac{\text{conc}_y}{\text{RBC}_y} \right) + \left(\frac{\text{conc}_z}{\text{RBC}_z} \right) \dots \right] \times 10^{-5}$$

5. For each noncarcinogen, the hazard quotient (HQ) is calculated by dividing the site concentration remaining on-site by the applicable RBC and multiplying by the risk management level of 1. The hazard index (HI) is the summation of all HQs across all pathways that are affecting the same target organ or system endpoint. The equation is as follows:

$$\text{Hazard Index} = \left[\left(\frac{\text{conc}_x}{\text{RBC}_x} \right) + \left(\frac{\text{conc}_y}{\text{RBC}_y} \right) + \left(\frac{\text{conc}_z}{\text{RBC}_z} \right) \dots \right] \times 1$$

Soil cleanup levels through methods two and three address ingestion of soil, inhalation of volatile chemicals and chemical particulates from soil in outdoor ambient air, and dermal contact with soil. Cleanup levels for groundwater at Table C address ingestion of groundwater, dermal contact with groundwater, and inhalation of volatiles from groundwater.

All other pathways that are shown to be complete based on the site-specific CSM should be investigated. These include indoor air from vapor intrusion as well as consumption of wild foods or exposure as a result of other site uses. The vapor intrusion pathway can be addressed through a site-specific analysis following ADEC's Vapor Intrusion Guidance (2012), while other pathways can be addressed through a method four risk assessment.

The RBCs for compounds not listed in Tables B1 and C and for compounds where alternative cleanup levels under method three are proposed, must be calculated on a site-specific basis using ADEC's Risk Assessment Procedures Manual (RAPM) 2015.

3.0 CUMULATIVE RISK AND GROUNDWATER

Unless it is shown that the groundwater at the site is not used or could not potentially be used for human consumption, it should be assumed that these groundwater pathways are complete. Therefore, chemicals found in groundwater at one-tenth of the Table C values need to be included in the cumulative risk calculations.

Table C values were developed using ADEC's PCCL 2015. Levels developed using the risk-based equations in the PCCL are based on an HQ of 1 or a lifetime excess cancer risk of 1×10^{-5} for ingestion of groundwater, inhalation of volatiles from groundwater and dermal contact with groundwater. The RBCs associated with the three groundwater exposure pathways are shown in Appendix B.

4.0 CUMULATIVE RISK UNDER METHOD FOUR

When conducting a method four risk assessment, compounds found at levels that correspond to greater than the risk based benchmarks of 1×10^{-6} risk or HQ of 0.1 will be retained for further analysis and are therefore included in the cumulative risk calculations. See ADEC's RAPM 2015 for more information.

5.0 CHEMICALS WITH SPECIAL CONSIDERATIONS

The following sections detail procedures for incorporating PCBs, dioxins, and lead in cumulative risk calculations. For additional information and assistance with these compounds please contact ADEC's risk assessor.

5.1 PCBs

Polychlorinated biphenyls (PCBs) are included in cumulative risk calculations although the cleanup levels are determined on a site-specific basis, based on land use, or through a site-specific risk assessment. If separate congener or Aroclor concentrations are present, the appropriate toxicological data can be used to calculate cancer risk. At the time of this document, EPA's *Integrated Risk Information System* (IRIS) had individual assessments for seven different Aroclors: 1016, 1221, 1232, 1242, 1248, 1254 and 1260.³ In addition IRIS has individual assessments for a handful of specific congeners. If PCBs are presented as a total concentration, the most conservative cancer slope factor and reference dose should be used.

5.2 Dioxins

Risks from dioxins are calculated based on a 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ) approach and should be included in cumulative risk calculations. Toxicity equivalency factors (TEFs) are used to compare the relative toxicity of individual dioxin-like compounds to the more toxic TCDD. Included in this calculation are dioxins, furans, and dioxin-like PCBs. The TEQ approach is based on the assumption that dioxin and dioxin-like compounds act through the same mechanism of toxicity. The TEF for TCDD is equal to one, whereas the TEF

³ Available at: <http://www.epa.gov/IRIS/>

values for all other dioxins and dioxin-like compounds are equal to less than one. The TEQ is defined as the product of the concentration of an individual dioxin-like compound (C_i) and the corresponding TEF for that compound (TEF_i). The total TEQ is the sum of the TEQ for each of the congeners in a given mixture.

$$Total\ TEQ = \sum(C_i \times TEF_i)$$

Once the total TEQ is calculated, this value can be compared to the dioxin slope factor and the risk can be calculated. The most current toxicological data and TEFs should be used when calculating risk to dioxins. As of July 2015, the World Health Organization remains the leading recommended source under ADEC's *Hierarchy of Toxicity Sources and MCLs* (2015) (Appendix C) for TEFs.⁴

5.3 Lead

Lead contamination in soil or groundwater is not included in cumulative risk calculations. EPA found it inappropriate to apply a reference dose or cancer slope factor to lead (IRIS, 1988). The residential lead soil cleanup level in Table B1 is based on the Integrated Exposure Uptake Biokinetic (IEUBK) model. Soil cleanup levels for lead are site-specific, based on land use, and groundwater cleanup levels are presented in Table C. In addition, an alternative cleanup level may be proposed under a site-specific risk assessment.

Lead cleanup levels are based on land use; for residential land use, the soil cleanup level is 400 mg/kg. For commercial or industrial land use as applied in 18 AAC 75.340(e)(3), the soil cleanup level is 800 mg/kg. As part of a site-specific risk assessment conducted according to the RAPM 2015, approved exposure models may be used to evaluate exposure to a child resident or an adult worker. A responsible person may also propose an alternative cleanup level based on a chemical speciation of the lead present at the site, under a site-specific risk assessment. For soils contaminated with lead more than 15 feet below ground surface, lead cleanup levels will be determined on a site-specific basis.

5.4 Chemicals Not Found in ADEC Tables

To evaluate cumulative risk from a chemical for which no ADEC regulatory criteria is available, the first step is to consult the EPA Regional Screening Levels (RSL) table (available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm) and compare the site concentration with the listed screening level for residential receptors. If it exceeds the value listed, which equates to a noncarcinogenic risk at $HQ = 0.1$ and cancer risk at 1×10^{-6} then consult with ADEC staff to calculate a method two cleanup level using the process outlined in the RAPM 2015. Toxicity and chemical data specific to the compound of concern will be needed. Toxicity data can be obtained from EPA's IRIS, EPA's *Provisional Peer Reviewed Toxicity Values (PPRTVs)*⁵, or another accepted source (see Appendix C). Chemical data can be obtained from an accepted chemistry source such as the Risk Assessment Information System (RAIS).⁶

⁴ World Health Organization. 2005. International Programme on Chemical Safety, Toxicity equivalent factors for dioxins, furans, and dioxin-like PCBs. Available at: http://www.who.int/foodsafety/chem/tef_update/en/index.html

⁵ Available at: <http://hhpprtv.ornl.gov/>

⁶ Available at: <http://rais.ornl.gov/>

Next, if the highest concentration remaining in soil or groundwater exceeds 1/10th of the calculated value, proceed with the steps as described in Section 2.2 of these procedures, including evaluating complete exposure pathways and comparing with the route-specific RBC(s) developed as part of the cleanup criteria calculations and validated by ADEC.

5.5 Naturally Occurring Compounds

DEC recommends the use of the U.S. Environmental Protection Agency's *Guidance for Comparing Background and Chemical Concentrations in Soil for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Sites* (USEPA, 2002), for determining if compounds found on site are attributable to background levels. If a chemical found at the site is shown to be solely attributable to naturally occurring background concentrations, then the chemical is not included in the cumulative risk calculations. For arsenic specifically, see ADEC's Arsenic Technical Memorandum (DEC 2009).⁷

5.6 Petroleum Hydrocarbons

Each petroleum fraction is a mixture of many different chemicals. The Total Petroleum Hydrocarbon Criteria Working Group identified indicator contaminants to represent the toxicity of the petroleum fractions. Individual risks for each petroleum fraction are then calculated based on these indicator compounds (listed in the table below). In order to accomplish this, analytical data for these compounds must be collected at sites with petroleum contamination. If these indicator compounds are not present at greater than 1/10 of the cleanup level in Tables B1 and C, then no further assessment of cumulative risk is required; however site cleanup levels for petroleum fractions still must be met.

⁷ Available at: <http://dec.alaska.gov/spar/guidance.htm#levels>

INDICATOR COMPOUNDS
FOR PETROLEUM CONTAMINATED SITES

<p><i>Volatiles (BTEX)</i></p> <ul style="list-style-type: none"> Benzene* Toluene Ethylbenzene* Total xylenes <p><i>Polynuclear Aromatic Hydrocarbons (PAHs) -</i></p> <ul style="list-style-type: none"> Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene* Benzo(b)fluoranthene* Benzo(k)fluoranthene* Benzo(g,h,i)perylene Benzo(a)pyrene* Chrysene * Dibenzo(a,h)anthracene* Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene* Naphthalene Phenanthrene Pyrene 	<p><i>Metals as required on a case by case basis</i></p> <ul style="list-style-type: none"> Arsenic* Barium Cadmium Chromium Lead Nickel Vanadium <p><i>Others as needed on a case by case basis</i></p> <ul style="list-style-type: none"> Ethylene dibromide (EDB)* 1,2-dichloroethane (EDC)* Methyl tert-butyl ether (MTBE)* Volatile organic compounds (VOCs)*
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* = carcinogenic

The carcinogenic risk of petroleum can be adequately evaluated by determining the risk from carcinogenic indicator compounds. Using the same rationale, noncarcinogenic effects of petroleum can be evaluated by calculating the HI for the indicator contaminants listed in Tables B1 and C. Therefore, the department believes that calculating cumulative risk for the indicator contaminants, in addition to other contaminants on-site, is protective of the cumulative risk to petroleum exposure, provided that site cleanup levels for the petroleum fractions are also met.

The department understands that there are petroleum constituents that will not be captured using this method. For many of these constituents the toxicity of the compounds has not yet been determined or there is minimal risk due to exposure. Petroleum is a chemical mixture. Under the *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA, 1986), the most preferred method for evaluating the risk to chemical mixtures is to use toxicological data for the mixture itself. Many mixtures have different toxicological properties than their constituents. The best available method for assessing risk to petroleum mixtures is to use a surrogate approach to determine cumulative risk. This is done by developing reference doses for each carbon range and then summing the HQs to produce the HI as explain in the PCCL 2015. However, at this time, there is not enough toxicological data available to calculate risk from the full petroleum fractions. Mixtures in petroleum fractions vary by product type and refining process and are altered further by weathering in the environment.

In light of this level of uncertainty, the PCCL 2015 attempts to compensate for the unknown risk from the six aromatic and aliphatic fractions by adopting conservative percentages for the composition of each fraction within each petroleum range (gasoline range organics, diesel range organics, and residual range organics); therefore the fractions are not included in the cumulative risk calculations where the petroleum indicator compounds are used. See Section 6.10 of the PCCL 2015 for more information. The department continues to investigate this issue with the goal of decreasing the uncertainty for risk with a scientifically accurate approach to quantifying the full risk from the petroleum fractions.

6.0 CUMULATIVE RISK CALCULATIONS FOR METHOD THREE

If alternative cleanup levels have been developed under method three, the carcinogenic risk or HQ from each constituent and the cumulative risk are calculated in the same fashion as described in Section 2.2. The site concentration following cleanup is divided by the RBC and the quotient is multiplied by the target risk standard. When using method three cleanup levels with site-specific data, the RBCs in Appendix B cannot be used; instead the same site-specific parameters must be used to produce the method three RBCs. See ADEC's PCCL 2015.

7.0 ADDITIONAL PATHWAYS TO INVESTIGATE

Upon completion of the CSM evaluation, exposure pathways other than those accounted for in Tables B1, B2 and C may be found to be complete. Such exposure pathways may include the indoor air vapor pathway, consumption of cultivated or wild foods at the site, and exposures based on recreational use. Vapor intrusion may be addressed through a site-specific analysis using ADEC's Vapor Intrusion Guidance (2012), while other pathways will require a method four risk assessment. Tables B1, B2 and C include the following exposure routes for soil: dermal contact, ingestion, and inhalation of volatiles and particulates from ambient air; and include the following exposure routes for groundwater: dermal contact, ingestion, and inhalation of volatiles. All completed pathways must be included in cumulative risk calculations including those pathways not addressed in Tables B1 and C.

8.0 ROUNDING IN CUMULATIVE RISK

Under 18 AAC 75.325(g) or 18 AAC 78.600(d), a responsible person must ensure that, after completing site cleanup using methods two or three, the risk from hazardous substances does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and a cumulative noncarcinogenic risk standard at a hazard index of 1, rounded to one significant figure, for all exposure pathways. Similarly, under 18 AAC 75.325(h), a responsible person proposing an alternative cleanup level for soil or groundwater based on a site-specific risk assessment under method four must ensure that the risk from hazardous substances does not exceed the cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and the cumulative noncarcinogenic risk standard at a hazard index of 1 for all exposure pathways.

Both cumulative risk summations for the incremental lifetime cancer risk and the HI should be expressed using one significant figure. The risk for an individual exposure pathway for a chemical, either the cancer risk or the hazard quotient should be shown to two significant figures. These then would be rounded to one significant figure after calculating the cumulative risk.

Standard rounding procedures must be adhered to such that: Starting from the left most significant digit, move to the right until you have as many digits as you are allowed to keep. Then look to the immediate right and note the number present. If the number to the right is a 5, 6, 7, 8, or 9, round the last significant digit up one. If the number to the right is a 4, 3, 2, 1, or 0, keep the last significant digit the same. Therefore, the rounding procedures and cumulative risk standards are consistent between methods two, three, and four.

9.0 ECOLOGICAL RECEPTORS

The noncarcinogenic HI is calculated for ecological receptors. The ecological noncarcinogenic risk management level is set at a HI of 1. Carcinogens are not considered to be of concern for ecological receptors. The HI is the sum of HQs across multiple exposure routes and exposure pathways. The HQ is calculated by dividing the dose by a risk-based ecological benchmark.

$$HI = \Sigma Dose \div Benchmark$$

If the HI exceeds 1, the individual HQs should be retained for further evaluation. See ADEC's RAPM 2015 for additional information.

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APPENDIX A: WORKSHEET FOR CALCULATING CUMULATIVE RISK

Chemicals of Concern Carcinogens	Exposure Media	Exposure Route	Site Concentration (mg/kg, mg/L or mg/m ³)	RBC	Conc÷RBC
$\text{Cumulative Carcinogenic Risk} = \left[\frac{(\text{conc}_x)}{(\text{RBC}_x)} + \frac{(\text{conc}_y)}{(\text{RBC}_y)} + \frac{(\text{conc}_z)}{(\text{RBC}_z)} \dots \right] \times 10^{-5}$				$\Sigma (\text{Conc} \div \text{RBC}) \times 10^{-5}$	Total
Chemicals of Concern Noncarcinogens	Exposure Media	Exposure Route	Site Concentration (mg/kg, mg/L or mg/m ³)	RBC	Conc÷RBC
$\text{Cumulative Noncarcinogenic Risk} = \left[\frac{(\text{conc}_x)}{(\text{RBC}_x)} + \frac{(\text{conc}_y)}{(\text{RBC}_y)} + \frac{(\text{conc}_z)}{(\text{RBC}_z)} \dots \right] \times 1$				$\Sigma (\text{Conc} \div \text{RBC}) \times 1$	Total

mg/kg = milligrams per kilogram
 mg/L – milligrams per liter
 RBC = risk based concentration

_____ Site Name

APPENDIX B: HUMAN HEALTH RISK BASED CONCENTRATIONS

SOIL ARCTIC ZONE

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Acenaphthene	83-32-9	No	8210	26600	-	-	-	-
Acenaphthylene ²	208-96-8	No	4110	13300	-	-	-	-
Acetone	67-64-1	No	1.23 x 10 ⁵	-	1.09 x 10 ⁶	-	-	-
Aldrin	309-00-2	No	4.11	-	-	0.716	-	10.5
Ammonium Perchlorate	7790-98-9	No	95.8	-	-	-	-	-
Anthracene	120-12-7	No	41100	1.33 x 10 ⁵	-	-	-	-
Antimony (metallic)	7440-36-0	No	54.8	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	68.4	577	40200	13.5	96.1	16800
Barium	7440-39-3	No	27400	-	1340000	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	3.67	11.0	432
Benzaldehyde	100-52-7	No	13700	-	-	-	-	-
Benzene	71-43-2	No	548	-	154	221	-	17.7
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.367	1.10	23700
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	3.67	11.0	2.37 x 10 ⁵
Benzo[g,h,i]perylene ²	191-24-2	No	4110	13300	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	36.7	110	2.37 x 10 ⁵

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Benzoic Acid	65-85-0	No	5.48 x 10 ⁵	2.31 x 10 ⁶	-	-	-	-
Benzyl Alcohol	100-51-6	No	13700	57700	-	-	-	-
Beryllium and compounds	7440-41-7	No	274	-	53700	-	-	30100
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	11.1	-	6.34
Bis(2-ethylhexyl)phthalate	117-81-7	No	2740	11500	-	869	3090	3.01 x 10 ⁷
Bromobenzene	108-86-1	No	1100	-	658	-	-	-
Bromodichloromethane	75-27-4	No	2740	-	-	196	-	5.45
Bromoform	75-25-2	No	2740	-	-	1540	-	438
Bromomethane	74-83-9	No	192	-	16.1	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.16	3.58	-	1.87
Butanol, N-	71-36-3	No	13700	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	27400	1.15 x 10 ⁵	-	6400	22800	-
Butylbenzene, n-	104-51-8	No	6840	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	13700	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	13700	-	-	-	-	-
Cadmium	7440-43-9	No	137	1440	26800	-	-	40100
Carbon Disulfide	75-15-0	No	13700	-	1830	-	-	-
Carbon Tetrachloride	56-23-5	No	548	-	320	174	-	14.4

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Chlordane	12789-03-6	No	68.4	721	701	34.8	309	270
Chlordecone (Kepone)	143-50-0	No	41.1	173	-	1.22	4.32	15700
Chloroaniline, p-	106-47-8	No	548	2310	-	60.8	216	-
Chlorobenzene	108-90-7	No	2740	-	424	-	-	-
Chloroform	67-66-3	No	1370	-	494	392	-	5.93
Chloromethane	74-87-3	No	-	-	246	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	11000	35500	-	-	-	-
Chlorophenol, 2-	95-57-8	No	684	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	2.05 x 10 ⁵	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	411	-	2.68 x 10 ⁵	5.36	-	311
Chromium, Total ³	7440-47-3	No	411	-	2.68 x 10 ⁵	5.36	-	311
Chrysene	218-01-9	Yes	-	-	-	367	1100	2.37 x 10 ⁶
Copper	7440-50-8	No	5480	-	-	-	-	-
Cresol, m-	108-39-4	No	6840	28800	1.61 x 10 ⁹	-	-	-
Cresol, o-	95-48-7	No	6840	28800	1.61 x 10 ⁹	-	-	-
Cresol, p-	106-44-5	No	13700	57700	1.61 x 10 ⁹	-	-	-
Cumene	98-82-8	No	13700	-	3040	-	-	-
Cyanide (CN-) ⁴	57-12-5	No	82.1	-	7.59	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Cyclohexane	110-82-7	No	-	-	13800	-	-	-
DDD	72-54-8	No	-	-	-	50.7	180	1.05 x 10 ⁶
DDE, p,p'-	72-55-9	No	-	-	-	35.8	-	648
DDT	50-29-3	No	68.4	961	-	35.8	424	7.45 x 10 ⁵
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.367	1.10	21700
Dibenzofuran	132-64-9	No	137	1920	-	-	-	-
Dibromochloromethane	124-48-1	No	2740	-	-	145	-	14.7
Dibromoethane, 1,2-	106-93-4	No	1230	-	137	6.08	-	0.685
Dibromomethane (Methylene Bromide)	74-95-3	No	1370	-	45.2	-	-	-
Dibutyl Phthalate	84-74-2	No	13700	57700	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	12300	-	2890	-	-	-
Dichlorobenzene, 1,3- ⁵	541-73-1	No	12300	-	2470	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	9580	-	10400	2250	-	31.7
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	27	96.1	2.12 x 10 ⁵
Dichlorodifluoromethane	75-71-8	No	27400	-	220	-	-	-
Dichloroethane, 1,1-	75-34-3	No	27400	-	-	2130	-	69
Dichloroethane, 1,2-	107-06-2	No	821	-	57	134	-	8.44

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dichloroethylene, 1,1-	75-35-4	No	6840	-	517	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	274	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	2740	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	411	1730	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	1370	11500	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	12300	-	25.2	338	-	17.0
Dichloropropene, 1,3-	542-75-6	No	4110	-	115	122	-	38.8
Dieldrin	60-57-1	No	6.84	28.8	-	0.76	2.70	15700
Diethyl Phthalate	84-66-2	No	1.10 x 10 ⁵	4.61 x 10 ⁵	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	2740	11500	-	-	-	-
Dimethylphthalate ⁶	131-11-3	No	1.10 x 10 ⁵	4.61 x 10 ⁵	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	13.7	57.7	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	13.7	57.7	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	13.7	57.7	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	274	1150	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	274	1130	-	39.2	137	8.12 x 10 ⁵
Dinitrotoluene, 2,6-	606-20-2	No	41.1	175	-	8.11	29.1	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	274	19200	-	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic?	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	274	12800	-	-	-	-
Dioxane, 1,4-	123-91-1	No	4110	-	3040	122	-	546
Diphenylamine	122-39-4	No	3420	14400	-	-	-	-
Endosulfan	115-29-7	No	821	-	-	-	-	-
Endrin	72-20-8	No	41.1	173	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	28500	-	-	-
Ethylbenzene	100-41-4	No	13700	-	7130	1110	-	76.8
Ethylene Glycol	107-21-1	No	2.74 x 10 ⁵	1.15 x 10 ⁶	1.07 x 10 ⁹	-	-	-
Fluoranthene	206-44-0	No	5480	17700	-	-	-	-
Fluorene	86-73-7	No	5480	17700	-	-	-	-
Formaldehyde	50-00-0	No	27400	-	2030	-	-	427
Heptachlor	76-44-8	No	68.4	-	-	2.70	-	11.0
Heptachlor Epoxide	1024-57-3	No	1.78	-	-	1.34	-	9.73
Hexachlorobenzene	118-74-1	No	110	-	-	7.60	-	4.45
Hexachlorobutadiene	87-68-3	No	137	-	-	156	-	15.9
Hexachlorocyclohexane, Alpha-	319-84-6	No	1100	4610	-	1.93	6.86	40100
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	6.76	24	1.36 x 10 ⁵

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Hexachlorocyclohexane, Gamma-(Lindane)	58-89-9	No	41.1	433	-	11.1	98.3	2.33 x 10 ⁵
Hexachlorocyclopentadiene	77-47-4	No	821	-	2.05	-	-	-
Hexachloroethane	67-72-1	No	95.8	-	326	304	-	26.6
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	411	11500	-	111	2620	-
Hexane, N-	110-54-3	No	8210	-	1540	-	-	-
Hexanone, 2-	591-78-6	No	684	-	845	-	-	-
Hydrazine ⁷	302-01-2	No	-	-	5.34	4.06	-	0.978
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	3.67	11.0	2.37 x 10 ⁵
Isophorone	78-59-1	No	27400	1.15 x 10 ⁵	5.37 x 10 ⁹	12800	45500	-
Isopropanol	67-63-0	No	2.74 x 10 ⁵	-	14500	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride ⁸	7487-94-7	No	41.1	-	8.05 x 10 ⁵	-	-	-
Mercury (elemental)	7439-97-6	No	21.9	-	24.6	-	-	-
Methanol	67-56-1	No	2.74 x 10 ⁵	-	1.54 x 10 ⁶	-	-	-
Methoxychlor	72-43-5	No	684	2880	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	82100	-	1.50 x 10 ⁵	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	11000	-	69200	-	-	-
Methyl Mercury ⁷	22967-92-6	No	13.7	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	32700	6760	-	1130
Methylene Chloride	75-09-2	Yes	821	-	2710	1340	-	4390
Methylnaphthalene, 1-	90-12-0	No	9580	31100	-	420	1150	-
Methylnaphthalene, 2-	91-57-6	No	548	1770	-	-	-	-
Naphthalene	91-20-3	No	2740	8870	159	-	-	41.8
Nickel Soluble Salts	7440-02-0	No	2740	-	2.41 x 10 ⁵	-	-	2.78 x 10 ⁵
Nitrobenzene	98-95-3	No	274	-	848	-	-	63.4
Nitroglycerin	55-63-0	No	13.7	57.7	-	716	2540	-
Nitroguanidine	556-88-7	No	13700	57700	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	1.10	-	6.45	0.0526	-	0.112
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.74	6.18	36100
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	2480	8830	2.78 x 10 ⁷
Nitrotoluene, m-	99-08-1	No	13.7	57.7	-	-	-	-
Nitrotoluene, o-	88-72-2	No	123	-	-	55.3	-	-
Nitrotoluene, p-	99-99-0	No	548	2310	-	760	2700	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	6840	4.81 x 10 ⁵	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	1370	5770	-	-	-	-
Pentachlorophenol	87-86-5	No	684	1150	-	30.4	43.2	1.42 x 10 ⁷
Pentaerythritol tetranitrate (PETN)	78-11-5	No	274	1150	-	3040	10800	-
Perfluorooctane Sulphonic Acid (PFOS) ⁹	1763-23-1	No	4.11	-	-	-	-	-
Perfluorooctanoic Acid (PFOA) ¹⁰	335-67-1	No	2.74	-	-	174	-	-
Phenanthrene ²	85-01-8	No	4110	13300	-	-	-	-
Phenol	108-95-2	No	41100	1.73 x 10 ⁵	5.37 x 10 ⁸	-	-	-
Phosphorus, White	7723-14-0	No	2.74	-	-	-	-	-
Polychlorinated Biphenyls (high risk)	1336-36-3	No	-	-	-	6.08	15.4	41.1
Propyl benzene	103-65-1	No	13700	-	8430	-	-	-
Pyrene	129-00-0	No	4110	13300	-	-	-	-
Selenium	7782-49-2	No	684	-	5.37 x 10 ⁷	-	-	-
Silver	7440-22-4	No	684	-	-	-	-	-
Styrene	100-42-5	No	27400	-	11400	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	9.58 x 10 ⁻⁵	0.00135	0.0871	9.36 x 10 ⁻⁵	0.00111	0.00154

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Tetrachloroethane, 1,1,2,2-	79-34-5	No	2740	-	-	60.8	-	10.3
Tetrachloroethylene	127-18-4	No	821	-	164	5790	-	424
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	274	1.77 x 10 ⁵	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	1.37	-	-	-	-	-
Toluene	108-88-3	No	11000	-	29000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	11.1	39.3	2.26 x 10 ⁵
Tributyltin	56573-85-4	No	-	-	-	-	-	-
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	4.11 x 10 ⁶	-	94800	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	110	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	1370	-	68.6	420	-	-
Trichloroethane, 1,1,1-	71-55-6	No	2.74 x 10 ⁵	-	16700	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	548	-	2.34	213	-	19.7
Trichloroethylene	79-01-6	Yes	68.4	-	7.95	154	-	18.2
Trichlorofluoromethane	75-69-4	No	41100	-	1770	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	13700	57700	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	137	577	-	1110	3930	2.33 x 10 ⁷

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	1370	5770	-	-	-	-
Trichlorophenoxypropionic acid, - 2,4,5	93-72-1	No	1100	4610	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	548	-	6.71	0.0893	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	67.2	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	1370	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	41.1	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	4110	91100	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	68.4	901	-	406	4500	-
Vanadium and Compounds	7440-62-2	No	690	-	2.68 x 10 ⁵	-	-	-
Vinyl Acetate	108-05-4	No	137000	-	2130	-	-	-
Vinyl Chloride	75-01-4	Yes	411	-	226	0.981	-	2.34
Xylenes	1330-20-7	No	27400	-	816	-	-	-
Zinc and Compounds	7440-66-6	No	41100	-	-	-	-	-

¹ "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System

² Pyrene is a toxicity surrogate for acenaphthylene, benzo[g,h,i]perylene, and phenanthrene

³ The cleanup level for total chromium assumes 100% of a detected concentration is chromium VI

⁴ Cyanide expressed as free, or physiologically available cyanide

⁵ 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene

⁶ Diethylphthalate is a toxicity surrogate for dimethylphthalate

⁷ Chloromethane is a toxicity surrogate for hydrazine and methyl mercury (Kd value only)

⁸ Elemental mercury is a toxicity surrogate for mercuric chloride

⁹ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctane Sulfonate (PFOS)*

¹⁰ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctanoic Acid (PFOA)*

SOIL UNDER 40 INCH ZONE

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Acenaphthene	83-32-9	No	6080	19700	-	-	-	-
Acenaphthylene ²	208-96-8	No	3040	9860	-	-	-	-
Acetone	67-64-1	No	91300	-	743000	-	-	-
Aldrin	309-00-2	No	3.04	-	-	0.530	-	7.15
Ammonium Perchlorate	7790-98-9	No	71.0	-	-	-	-	-
Anthracene	120-12-7	No	30400	98600	-	-	-	-
Antimony (metallic)	7440-36-0	No	40.6	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	50.7	427	27600	10.0	71.2	11500
Barium	7440-39-3	No	20300	-	9.19 x 10 ⁵	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.72	8.15	295
Benzaldehyde	100-52-7	No	10100	-	-	-	-	-
Benzene	71-43-2	No	406	-	105	164	-	12.1
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.272	0.815	16200
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.72	8.15	1.62 x 10 ⁵

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Benzo[g,h,i]perylene ²	191-24-2	No	3040	9860	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	27.2	81.5	1.62 x 10 ⁵
Benzoic Acid	65-85-0	No	4.06 x 10 ⁵	1.71 x 10 ⁶	-	-	-	-
Benzyl Alcohol	100-51-6	No	10100	42700	-	-	-	-
Beryllium and compounds	7440-41-7	No	203	-	36800	-	-	20600
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	8.19	-	4.33
Bis(2-ethylhexyl)phthalate	117-81-7	No	2030	8550	-	644	2290	2.06 x 10 ⁵
Bromobenzene	108-86-1	No	811	-	450	-	-	-
Bromodichloromethane	75-27-4	No	2030	-	-	145	-	3.73
Bromoform	75-25-2	No	2030	-	-	1140	-	300
Bromomethane	74-83-9	No	142	-	11.0	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.85	2.65	-	1.28
Butanol, N-	71-36-3	No	10100	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	20300	85500	-	4740	16900	-
Butylbenzene, n-	104-51-8	No	5070	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	10100	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	10100	-	-	-	-	-
Cadmium	7440-43-9	No	101	1070	18400	-	-	27500

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Carbon Disulfide	75-15-0	No	10100	-	1250	-	-	-
Carbon Tetrachloride	56-23-5	No	406	-	219	129	-	9.81
Chlordane	12789-03-6	No	50.7	534	480	25.7	229	184
Chlordecone (Kepone)	143-50-0	No	30.4	128	-	0.901	3.20	10800
Chloroaniline, p-	106-47-8	No	406	1710	-	45.1	160	-
Chlorobenzene	108-90-7	No	2030	-	290	-	-	-
Chloroform	67-66-3	No	1010	-	338	291	-	4.05
Chloromethane	74-87-3	No	-	-	168	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	8110	26300	-	-	-	-
Chlorophenol, 2-	95-57-8	No	507	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	-	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	1.52 x 10 ⁵	-	-	-	-	-
Chromium, Total ³	7440-47-3	No	304	-	1.84 x 10 ⁵	3.97	-	213
Chrysene	218-01-9	Yes	304	-	1.84 x 10 ⁵	18.0	-	589
Copper	7440-50-8	No	-	-	-	272	815	1.62 x 10 ⁶
Cresol, m-	108-39-4	No	4060	-	-	-	-	-
Cresol, o-	95-48-7	No	5070	21400	1.10 x 10 ⁹	-	-	-
Cresol, p-	106-44-5	No	5070	21400	1.10 x 10 ⁹	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Cumene	98-82-8	No	10100	42700	1.10 x 10 ⁹	-	-	-
Cyanide (CN) ⁴	57-12-5	No	10100	-	2080	-	-	-
Cyclohexane	110-82-7	No	60.8	-	5.19	-	-	-
DDD	72-54-8	No	-	-	9440	-	-	-
DDE, p,p'-	72-55-9	No	-	-	-	37.6	133	7.17 x 10 ⁵
DDT	50-29-3	No	-	-	-	26.5	-	443
Dibenz[a,h]anthracene	53-70-3	Yes	50.7	712	-	26.5	314	5.10 x 10 ⁵
Dibenzofuran	132-64-9	No	-	-	-	0.272	0.815	14900
Dibromochloromethane	124-48-1	No	101	1420	-	-	-	-
Dibromoethane, 1,2-	106-93-4	No	2030	-	-	107	-	10.0
Dibromomethane (Methylene Bromide)	74-95-3	No	913	-	94.0	4.51	-	0.468
Dibutyl Phthalate	84-74-2	No	1010	-	30.9	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	10100	42700	-	-	-	-
Dichlorobenzene, 1,3- ⁵	541-73-1	No	9130	-	1970	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	9130	-	1690	-	-	-
Dichlorobenzidine, 3,3'-	91-94-1	No	7100	-	7090	1670	-	21.7
Dichlorodifluoromethane	75-71-8	No	-	-	-	20.0	71.2	146000

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dichloroethane, 1,1-	75-34-3	No	20300	-	150	-	-	-
Dichloroethane, 1,2-	107-06-2	No	20300	-	-	1580	-	47.2
Dichloroethylene, 1,1-	75-35-4	No	608	-	39.0	99.0	-	5.77
Dichloroethylene, 1,2-cis-	156-59-2	No	5070	-	354	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	203	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	2030	-	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	304	1280	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	1010	8550	-	-	-	-
Dichloropropene, 1,3-	542-75-6	No	9130	-	17.3	250	-	11.6
Dieldrin	60-57-1	No	3040	-	78.9	90.1	-	26.6
Diethyl Phthalate	84-66-2	No	5.07	21.4	-	0.563	2.00	10800
Dimethylphenol, 2,4-	105-67-9	No	81100	3.42 x 10 ⁵	-	-	-	-
Dimethylphthalate ⁶	131-11-3	No	2030	8550	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	81100	3.42 x 10 ⁵	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	10.1	42.7	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	10.1	42.7	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	10.1	42.7	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	203	855	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dinitrotoluene, 2,6-	606-20-2	No	203	838	-	29.1	101	5.56 x 10 ⁵
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	30.4	129	-	6.01	21.6	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	203	14200	-	-	-	-
Dioxane, 1,4-	123-91-1	No	203	9490	-	-	-	-
Diphenylamine	122-39-4	No	3040	-	2080	90.1	-	374
Endosulfan	115-29-7	No	2530	10700	-	-	-	-
Endrin	72-20-8	No	608	-	-	-	-	-
Ethyl Chloride	75-00-3	No	30.4	128	-	-	-	-
Ethylbenzene	100-41-4	No	-	-	19500	-	-	-
Ethylene Glycol	107-21-1	No	10100	-	4870	819	-	52.5
Fluoranthene	206-44-0	No	2.03 x 10 ⁵	8.55 x 10 ⁵	7.35 x 10 ⁸	-	-	-
Fluorene	86-73-7	No	4060	13100	-	-	-	-
Formaldehyde	50-00-0	No	4060	13100	-	-	-	-
Heptachlor	76-44-8	No	20300	-	1390	-	-	292
Heptachlor Epoxide	1024-57-3	No	50.7	-	-	2.00	-	7.54
Hexachlorobenzene	118-74-1	No	1.32	-	-	0.990	-	6.65
Hexachlorobutadiene	87-68-3	No	81.1	-	-	5.63	-	3.04
Hexachlorocyclohexane, Alpha-	319-84-6	No	101	-	-	116	-	10.8

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Hexachlorocyclohexane, Beta-	319-85-7	No	811	3420	-	1.43	5.08	27500
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	-	-	-	5.01	17.8	93400
Hexachlorocyclopentadiene	77-47-4	No	30.4	320	-	8.19	72.8	1.60 x 10 ⁵
Hexachloroethane	67-72-1	No	608	-	1.40	-	-	-
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	71.0	-	223	225	-	18.2
Hexane, N-	110-54-3	No	304	8550	-	81.9	1940	-
Hexanone, 2-	591-78-6	No	6080	-	1060	-	-	-
Hydrazine ⁷	302-01-2	No	507	-	578	-	-	-
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	3.65	3.00	-	0.669
Isophorone	78-59-1	No	-	-	-	2.72	8.15	1.62 x 10 ⁵
Isopropanol	67-63-0	No	20300	85500	3.68 x 10 ⁹	9490	33700	-
Lead and Compounds	7439-92-1	No	2.03 x 10 ⁵	-	9940	-	-	-
Mercuric Chloride ⁸	7487-94-7	No	-	-	-	-	-	-
Mercury (elemental)	7439-97-6	No	30.4	-	552000	-	-	-
Methanol	67-56-1	No	16.2	-	16.8	-	-	-
Methoxychlor	72-43-5	No	2.03 x 10 ⁵	-	1.05 x 10 ⁶	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	507	2140	-	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	60800	-	1.03 x 10 ⁵	-	-	-
Methyl Mercury ⁷	22967-92-6	No	8110	-	47300	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	10.1	-	-	-	-	-
Methylene Chloride	75-09-2	Yes	-	-	22300	5010	-	771
Methylnaphthalene, 1-	90-12-0	No	608	-	1850	993	-	3000
Methylnaphthalene, 2-	91-57-6	No	7100	23000	-	311	850	-
Naphthalene	91-20-3	No	406	1310	-	-	-	-
Nickel Soluble Salts	7440-02-0	No	2030	6570	108	-	-	28.6
Nitrobenzene	98-95-3	No	2030	-	1.65 x 10 ⁵	-	-	1.90 x 10 ⁵
Nitroglycerin	55-63-0	No	203	-	580	-	-	43.4
Nitroguanidine	556-88-7	No	10.1	42.7	-	530	1880	-
Nitrosodimethylamine, N-	62-75-9	Yes	10100	42700	-	-	-	-
Nitroso-di-N-propylamine, N-	621-64-7	No	0.811	-	4.41	0.0389	-	0.0766
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1.29	4.58	24700
Nitrotoluene, m-	99-08-1	No	-	-	-	1840	6540	1.90 x 10 ⁵
Nitrotoluene, o-	88-72-2	No	10.1	42.7	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Nitrotoluene, p-	99-99-0	No	91.3	-	-	41.0	-	-
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	406	1710	-	563	2000	-
Octyl Phthalate, di-N-	117-84-0	No	5070	356000	-	-	-	-
Pentachlorophenol	87-86-5	No	1010	4270	-	-	-	-
Pentaerythritol tetranitrate (PETN)	78-11-5	No	507	855	-	22.5	32.0	9.71 x 10 ⁶
Perfluorooctane Sulphonic Acid (PFOS) ⁹	1763-23-1	No	203	855	-	2250	8010	-
Perfluorooctanoic Acid (PFOA) ¹⁰	335-67-1	No	3.04	-	-	-	-	-
Phenanthrene ²	85-01-8	No	2.03	-	-	129	-	-
Phenol	108-95-2	No	3040	9860	-	-	-	-
Phosphorus, White	7723-14-0	No	30400	1.28 x 10 ⁵	3.68 x 10 ⁸	-	-	-
Polychlorinated Biphenyls (high risk)	1336-36-3	No	2.03	-	-	-	-	-
Propyl benzene	103-65-1	No	-	-	-	4.51	11.4	28.1
Pyrene	129-00-0	No	10100	-	5760	-	-	-
Selenium	7782-49-2	No	3040	9860	-	-	-	-
Silver	7440-22-4	No	507	-	3.68 x 10 ⁷	-	-	-
Styrene	100-42-5	No	507	-	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
TCDD, 2,3,7,8-	1746-01-6	No	20300	-	7820	-	-	-
Tetrachloroethane, 1,1,2,2-	79-34-5	No	7.10 x 10 ⁻⁵	0.000997	0.0595	6.93 x 10 ⁻⁵	0.00082 1	0.00105
Tetrachloroethylene	127-18-4	No	2030	-	-	45.1	-	7.07
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	608	-	112	4290	-	290
Thallium (Soluble Salts)	7440-28-0	No	203	1.31 x 10 ⁵	-	-	-	-
Toluene	108-88-3	No	1.01	-	-	-	-	-
Toxaphene	8001-35-2	No	8110	-	19800	-	-	-
Tributyltin	56573-85-4	No	-	-	-	8.19	29.1	1.55 x 10 ⁵
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	-	-	-	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	3.04 x 10 ⁶	-	64800	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	81.1	-	-	-	-	-
Trichloroethane, 1,1,1-	71-55-6	No	1010	-	46.9	311	-	-
Trichloroethane, 1,1,2-	79-00-5	No	2.03 x 10 ⁵	-	11400	-	-	-
Trichloroethylene	79-01-6	Yes	406	-	1.60	158	-	13.5
Trichlorofluoromethane	75-69-4	No	50.7	-	5.44	114	-	12.5
Trichlorophenol, 2,4,5-	95-95-4	No	30400	-	1210	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	10100	42700	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	101	427	-	819	2910	1.60 x 10 ⁵
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	1010	4270	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	811	3420	-	-	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	406	-	4.59	0.0662	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	-	-	45.9	-	-	-
Tri-n-butyltin	688-73-3	No	1010	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	30.4	-	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	3040	67500	-	-	-	-
Vanadium and Compounds	7440-62-2	No	50.7	668	-	300	3340	-
Vinyl Acetate	108-05-4	No	511	-	1.84 x 10 ⁵	-	-	-
Vinyl Chloride	75-01-4	Yes	1.01 x 10 ⁵	-	1460	-	-	-
Xylenes	1330-20-7	No	304	-	155	0.962	-	2.04
Zinc and Compounds	7440-66-6	No	20300	-	558	-	-	-

¹ "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System

² Pyrene is a toxicity surrogate for acenaphthylene, benzo[ghi]perylene, and phenanthrene

³ The cleanup level for total chromium assumes 100% of a detected concentration is chromium VI

⁴ Cyanide expressed as free, or physiologically available cyanide

⁵ 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene

⁶ Diethylphthalate is a toxicity surrogate for dimethylphthalate

⁷ Chloromethane is a toxicity surrogate for hydrazine and methyl mercury (Kd value only)

⁸ Elemental mercury is a toxicity surrogate for mercuric chloride

⁹ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctane Sulfonate (PFOS)*

¹⁰ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctanoic Acid (PFOA)*

SOIL OVER 40 INCH ZONE

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Acenaphthene	83-32-9	No	4980	16100	-	-	-	-
Acenaphthylene ²	208-96-8	No	2490	8070	-	-	-	-
Acetone	67-64-1	No	74700	-	5.73 x 10 ⁵	-	-	-
Aldrin	309-00-2	No	2.49	-	-	0.434	-	5.52
Ammonium Perchlorate	7790-98-9	No	58.1	-	-	-	-	-
Anthracene	120-12-7	No	24900	80700	-	-	-	-
Antimony (metallic)	7440-36-0	No	33.2	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	41.5	350	21200	8.19	58.2	8860
Barium	7440-39-3	No	16600	-	7.08 x 10 ⁵	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.23	6.67	228
Benzaldehyde	100-52-7	No	8300	-	-	-	-	-
Benzene	71-43-2	No	332	-	81.1	134	-	9.33
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.223	0.667	12500
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.23	6.67	1.25 x 10 ⁵
Benzo[g,h,i]perylene ²	191-24-2	No	2490	8070	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	22.3	66.7	1.25 x 10 ⁵

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Benzoic Acid	65-85-0	No	3.32 x 10 ⁵	1.40 x 10 ⁶	-	-	-	-
Benzyl Alcohol	100-51-6	No	8300	35000	-	-	-	-
Beryllium and compounds	7440-41-7	No	166	-	28300	-	-	15900
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	6.70	-	3.34
Bis(2-ethylhexyl)phthalate	117-81-7	No	1660	6990	-	527	1870	1.59 x 10 ⁵
Bromobenzene	108-86-1	No	664	-	347	-	-	-
Bromodichloromethane	75-27-4	No	1660	-	-	119	-	2.87
Bromoform	75-25-2	No	1660	-	-	933	-	231
Bromomethane	74-83-9	No	116	-	8.51	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.20	2.17	-	0.986
Butanol, N-	71-36-3	No	8300	-	-	-	-	-
Butyl Benzyl Phthalate	85-68-7	No	16600	69900	-	3880	13800	-
Butylbenzene, n-	104-51-8	No	4150	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	8300	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	8300	-	-	-	-	-
Cadmium	7440-43-9	No	83.0	874	14200	-	-	21200
Carbon Disulfide	75-15-0	No	8300	-	968	-	-	-
Carbon Tetrachloride	56-23-5	No	332	-	169	105	-	7.57

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Chlordane	12789-03-6	No	41.5	437	370	21.1	187	142
Chlordecone (Kepone)	143-50-0	No	24.9	105	-	0.737	2.62	8290
Chloroaniline, p-	106-47-8	No	332	1400	-	36.9	131	-
Chlorobenzene	108-90-7	No	1660	-	224	-	-	-
Chloroform	67-66-3	No	830	-	261	238	-	3.13
Chloromethane	74-87-3	No	-	-	130	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	6640	21500	-	-	-	-
Chlorophenol, 2-	95-57-8	No	415	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	1.24 x 10 ⁵	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	249	-	1.42 x 10 ⁵	3.25	-	164
Chromium, Total ³	7440-47-3	No	249	-	1.42 x 10 ⁵	14.7	-	454
Chrysene	218-01-9	Yes	-	-	-	223	667	1.25 x 10 ⁶
Copper	7440-50-8	No	3320	-	-	-	-	-
Cresol, m-	108-39-4	No	4150	17500	8.49 x 10 ⁸	-	-	-
Cresol, o-	95-48-7	No	4150	17500	8.49 x 10 ⁸	-	-	-
Cresol, p-	106-44-5	No	8300	35000	8.49 x 10 ⁸	-	-	-
Cumene	98-82-8	No	8300	-	1600	-	-	-
Cyanide (CN-) ⁴	57-12-5	No	49.8	-	4.01	-	-	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic?	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Cyclohexane	110-82-7	No	-	-	7280	-	-	-
DDD	72-54-8	No	-	-	-	30.7	109	552000
DDE, p,p'-	72-55-9	No	-	-	-	21.7	-	342
DDT	50-29-3	No	41.5	583	-	21.7	257	3.93 x 10 ⁵
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.223	0.667	11500
Dibenzofuran	132-64-9	No	83.0	1170	-	-	-	-
Dibromochloromethane	124-48-1	No	1660	-	-	87.8	-	7.74
Dibromoethane, 1,2-	106-93-4	No	747	-	72.5	3.69	-	0.361
Dibromomethane (Methylene Bromide)	74-95-3	No	830	-	23.8	-	-	-
Dibutyl Phthalate	84-74-2	No	8300	35000	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	7470	-	1520	-	-	-
Dichlorobenzene, 1,3- ⁵	541-73-1	No	7470	-	1300	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	5810	-	5470	1370	-	16.7
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	16.4	58.2	1.12 x 10 ⁵
Dichlorodifluoromethane	75-71-8	No	16600	-	116	-	-	-
Dichloroethane, 1,1-	75-34-3	No	16600	-	-	1290	-	36.4
Dichloroethane, 1,2-	107-06-2	No	498	-	30.1	81.0	-	4.45

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dichloroethylene, 1,1-	75-35-4	No	4150	-	273	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	166	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	1660	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	249	1050	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	830	6990	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	7470	-	13.3	205	-	8.96
Dichloropropene, 1,3-	542-75-6	No	2490	-	60.9	73.7	-	20.5
Dieldrin	60-57-1	No	4.15	17.5	-	0.461	1.64	8290
Diethyl Phthalate	84-66-2	No	66400	2.80 x 10 ⁵	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	1660	6990	-	-	-	-
Dimethylphthalate ⁶	131-11-3	No	66400	2.80 x 10 ⁵	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	8.30	35.0	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	8.30	35.0	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	8.30	35.0	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	166	699	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	166	685	-	23.8	82.9	4.28 x 10 ⁵
Dinitrotoluene, 2,6-	606-20-2	No	24.9	106	-	4.92	17.6	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	166	11700	-	-	-	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	166	7770	-	-	-	-
Dioxane, 1,4-	123-91-1	No	2490	-	1610	73.7	-	288
Diphenylamine	122-39-4	No	2070	8740	-	-	-	-
Endosulfan	115-29-7	No	498	-	-	-	-	-
Endrin	72-20-8	No	24.9	105	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	15100	-	-	-
Ethylbenzene	100-41-4	No	8300	-	3760	670	-	40.5
Ethylene Glycol	107-21-1	No	1.66 x 10 ⁵	6.99 x 10 ⁵	5.66 x 10 ⁸	-	-	-
Fluoranthene	206-44-0	No	3320	10800	-	-	-	-
Fluorene	86-73-7	No	3320	10800	-	-	-	-
Formaldehyde	50-00-0	No	16600	-	1070	-	-	225
Heptachlor	76-44-8	No	41.5	-	-	1.64	-	5.82
Heptachlor Epoxide	1024-57-3	No	1.08	-	-	0.810	-	5.13
Hexachlorobenzene	118-74-1	No	66.4	-	-	4.61	-	2.35
Hexachlorobutadiene	87-68-3	No	83.0	-	-	94.5	-	8.37
Hexachlorocyclohexane, Alpha-	319-84-6	No	664	2800	-	1.17	4.16	21200
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	4.10	14.6	71900

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Hexachlorocyclohexane, Gamma-(Lindane)	58-89-9	No	24.9	262	-	6.70	59.6	1.23 x 10 ⁵
Hexachlorocyclopentadiene	77-47-4	No	498	-	1.08	-	-	-
Hexachloroethane	67-72-1	No	58.1	-	172	184	-	14.0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	249	6990	-	67.0	1590	-
Hexane, N-	110-54-3	No	4980	-	814	-	-	-
Hexanone, 2-	591-78-6	No	415	-	446	-	-	-
Hydrazine ⁷	302-01-2	No	-	-	2.82	2.46	-	0.516
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	2.23	6.67	1.25 x 10 ⁵
Isophorone	78-59-1	No	16600	69900	2.83 x 10 ⁹	7760	27600	-
Isopropanol	67-63-0	No	1.66 x 10 ⁵	-	7670	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride ⁸	7487-94-7	No	24.9	-	4.25 x 10 ⁵	-	-	-
Mercury (elemental)	7439-97-6	No	13.3	-	13.0	-	-	-
Methanol	67-56-1	No	1.66 x 10 ⁵	-	8.13 x 10 ⁵	-	-	-
Methoxychlor	72-43-5	No	415	1750	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	49800	-	79400	-	-	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	6640	-	36500	-	-	-
Methyl Mercury ⁷	22967-92-6	No	8.30	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	17200	4100	-	595
Methylene Chloride	75-09-2	Yes	498	-	1430	812	-	2320
Methylnaphthalene, 1-	90-12-0	No	5810	18800	-	254	695	-
Methylnaphthalene, 2-	91-57-6	No	332	1080	-	-	-	-
Naphthalene	91-20-3	No	1660	5380	83.6	-	-	22.1
Nickel Soluble Salts	7440-02-0	No	1660	-	1.27 x 10 ⁵	-	-	1.47 x 10 ⁵
Nitrobenzene	98-95-3	No	166	-	447	-	-	33.5
Nitroglycerin	55-63-0	No	8.3	35.0	-	434	1540	-
Nitroguanidine	556-88-7	No	8300	35000	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.664	-	3.40	0.0318	-	0.0591
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.05	3.74	19100
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1500	5350	1.47 x 10 ⁷
Nitrotoluene, m-	99-08-1	No	8.30	35.0	-	-	-	-
Nitrotoluene, o-	88-72-2	No	74.7	-	-	33.5	-	-
Nitrotoluene, p-	99-99-0	No	332	1400	-	461	1640	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	4150	2.91 x 10 ⁵	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	830	3500	-	-	-	-
Pentachlorophenol	87-86-5	No	415	699	-	18.4	26.2	7.47 x 10 ⁶
Pentaerythritol tetranitrate (PETN)	78-11-5	No	166	699	-	1840	6550	-
Perfluorooctane Sulphonic Acid (PFOS) ⁹	1763-23-1	No	2.49	-	-	-	-	-
Perfluorooctanoic Acid (PFOA) ¹⁰	335-67-1	No	1.66	-	-	105	-	-
Phenanthrene ²	85-01-8	No	2490	8070	-	-	-	-
Phenol	108-95-2	No	24900	1.05 x 10 ⁵	2.83 x 10 ⁸	-	-	-
Phosphorus, White	7723-14-0	No	1.66	-	-	-	-	-
Polychlorinated Biphenyls (high risk)	1336-36-3	No	-	-	-	3.69	9.36	21.7
Propyl benzene	103-65-1	No	8300	-	4450	-	-	-
Pyrene	129-00-0	No	2490	8070	-	-	-	-
Selenium	7782-49-2	No	415	-	2.83 x 10 ⁷	-	-	-
Silver	7440-22-4	No	415	-	-	-	-	-
Styrene	100-42-5	No	16600	-	6040	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	5.81 x 10 ⁻⁵	0.000816	0.0459	5.67 x 10 ⁻⁵	0.00067 2	0.000813

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Tetrachloroethane, 1,1,2,2-	79-34-5	No	1660	-	-	36.9	-	5.46
Tetrachloroethylene	127-18-4	No	498	-	86.4	3510	-	224
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	166	1.08 x 10 ⁵	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.830	-	-	-	-	-
Toluene	108-88-3	No	6640	-	15300	-	-	-
Toxaphene	8001-35-2	No	-	-	-	6.70	23.8	1.19 x 10 ⁵
Tributyltin	56573-85-4	No	-	-	-	-	-	-
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	2.49 x 10 ⁶	-	50000	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	66.4	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	830	-	36.2	254	-	-
Trichloroethane, 1,1,1-	71-55-6	No	1.66 x 10 ⁵	-	8830	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	332	-	1.23	129	-	10.4
Trichloroethylene	79-01-6	Yes	41.5	-	4.20	93.1	-	9.62
Trichlorofluoromethane	75-69-4	No	24900	-	932	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	8300	35000	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	83.0	350	-	670	2380	1.23 x 10 ⁷
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	830	3500	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	664	2800	-	-	-	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Trichloropropane, 1,2,3-	96-18-4	Yes	332	-	3.54	0.0541	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	35.4	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	830	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	24.9	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	2490	55200	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	41.5	546	-	246	2730	-
Vanadium and Compounds	7440-62-2	No	418	-	1.42 x 10 ⁵	-	-	-
Vinyl Acetate	108-05-4	No	83000	-	1130	-	-	-
Vinyl Chloride	75-01-4	Yes	249	-	119	0.945	-	1.83
Xylenes	1330-20-7	No	16600	-	430	-	-	-
Zinc and Compounds	7440-66-6	No	24900	-	-	-	-	-

¹ "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System

² Pyrene is a toxicity surrogate for acenaphthylene, benzo[g,h,i]perylene, and phenanthrene

³ The cleanup level for total chromium assumes 100% of a detected concentration is chromium VI

⁴ Cyanide expressed as free, or physiologically available cyanide

⁵ 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene

⁶ Diethylphthalate is a toxicity surrogate for dimethylphthalate

⁷ Chloromethane is a toxicity surrogate for hydrazine and methyl mercury (Kd value only)

⁸ Elemental mercury is a toxicity surrogate for mercuric chloride

⁹ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctane Sulfonate (PFOS)*

¹⁰ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctanoic Acid (PFOA)*

GROUNDWATER

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Acenaphthene	83-32-9	No	1200	961	-	-	-	-
Acenaphthylene ²	208-96-8	No	602	460	-	-	-	-
Acetone	67-64-1	No	18000	4.38 x 10 ⁶	64400	-	-	-
Aldrin	309-00-2	No	0.602	-	-	0.0458	-	0.0115
Ammonium Perchlorate	7790-98-9	No	14.0	3180	-	-	-	-
Anthracene	120-12-7	No	6020	2490	-	-	-	-
Antimony (metallic)	7440-36-0	No	8.02	273	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	6.02	1360	-	0.519	93.3	-
Barium	7440-39-3	No	4010	63600	-	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	0.343	-	0.184
Benzaldehyde	100-52-7	No	2010	49000	-	-	-	-
Benzene	71-43-2	No	80.2	604	62.6	14.2	94.3	7.20
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.0343	-	-
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	0.343	-	-
Benzo[g,h,i]perylene ²	191-24-2	No	602	-	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	3.43	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Benzoic Acid	65-85-0	No	80200	1.20 x 10 ⁶	-	-	-	-
Benzyl Alcohol	100-51-6	No	2010	88700	-	-	-	-
Beryllium and compounds	7440-41-7	No	40.1	63.6	-	-	-	-
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	0.708	26.0	0.170
Bis(2-ethylhexyl)phthalate	117-81-7	No	401	-	-	55.6	-	-
Bromobenzene	108-86-1	No	160	541	125	-	-	-
Bromodichloromethane	75-27-4	No	401	6440	-	12.6	178	1.52
Bromoform	75-25-2	No	401	6210	-	98.6	1350	51.0
Bromomethane	74-83-9	No	28.1	995	10.4	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.17	0.229	1.55	1.87
Butanol, N-	71-36-3	No	2010	1.00 x 10 ⁵	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	4010	2870	-	410	259	-
Butylbenzene, n-	104-51-8	No	1000	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	2010	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	2010	1050	-	-	-	-
Cadmium	7440-43-9	No	10.0	114	-	-	-	-
Carbon Disulfide	75-15-0	No	2010	20000	1460	-	-	-
Carbon Tetrachloride	56-23-5	No	80.2	339	209	11.1	41.6	9.36

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Chlordane	12789-03-6	No	10.0	-	1.46	2.23	-	0.562
Chlordecone (Kepone)	143-50-0	No	6.02	5.42	-	0.0779	0.0620	-
Chloroaniline, p-	106-47-8	No	80.2	1320	-	3.90	56.6	-
Chlorobenzene	108-90-7	No	401	1280	104	-	-	-
Chloroform	67-66-3	No	201	2530	204	25.1	280	2.44
Chloromethane	74-87-3	No	-	-	188	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	1600	1390	-	-	-	-
Chlorophenol, 2-	95-57-8	No	100	1020	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	30100	88600	-	-	-	-
Chromium(VI)	18540-29-9	Yes	60.2	170	-	0.501	1.13	-
Chromium, Total ³	7440-47-3	No	60.2	177	-	1.56	3.64	-
Chrysene	218-01-9	Yes	-	-	-	34.3	-	-
Copper	7440-50-8	No	802	1.82 x 10 ⁵	-	-	-	-
Cresol, m-	108-39-4	No	1000	11900	-	-	-	-
Cresol, o-	95-48-7	No	1000	12100	-	-	-	-
Cresol, p-	106-44-5	No	2010	24600	-	-	-	-
Cumene	98-82-8	No	2010	1910	834	-	-	-
Cyanide (CN-) ⁴	57-12-5	No	12.0	2730	1.67	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic?	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Cyclohexane	110-82-7	No	-	-	12500	-	-	-
DDD	72-54-8	No	-	-	-	3.25	0.337	-
DDE, p,p'-	72-55-9	No	-	-	-	2.29	-	0.579
DDT	50-29-3	No	10.0	-	-	2.29	-	-
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.0343	-	-
Dibenzofuran	132-64-9	No	20.1	12.9	-	-	-	-
Dibromochloromethane	124-48-1	No	401	6730	-	9.27	138	2.08
Dibromoethane, 1,2-	106-93-4	No	180	3590	18.8	0.390	6.85	0.0936
Dibromomethane (Methylene Bromide)	74-95-3	No	201	5440	8.34	-	-	-
Dibutyl Phthalate	84-74-2	No	2010	1640	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	1800	2910	417	-	-	-
Dichlorobenzene, 1,3- ⁵	541-73-1	No	1800	2500	417	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	1400	2230	1670	144	203	5.10
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	1.73	4.34	-
Dichlorodifluoromethane	75-71-8	No	4010	38200	209	-	-	-
Dichloroethane, 1,1-	75-34-3	No	4010	58300	-	137	1760	35.1
Dichloroethane, 1,2-	107-06-2	No	120	2810	14.6	8.56	177	2.16

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dichloroethylene, 1,1-	75-35-4	No	1000	8520	417	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	40.1	362	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	401	3620	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	60.2	190	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	201	1350	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	1800	21500	8.34	21.6	228	5.62
Dichloropropene, 1,3-	542-75-6	No	602	6550	41.7	7.79	75.0	14.0
Dieldrin	60-57-1	No	1.00	0.612	-	0.0487	0.0263	-
Diethyl Phthalate	84-66-2	No	16000	1.97 x 10 ⁵	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	401	3110	-	-	-	-
Dimethylphthalate ⁶	131-11-3	No	16000	5.79 x 10 ⁵	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	2.01	53.2	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	2.01	72.4	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	2.01	75.4	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	40.1	1220	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	40.1	747	-	2.51	41.4	-
Dinitrotoluene, 2,6-	606-20-2	No	6.02	93.3	-	0.519	7.12	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	40.1	1020	-	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	40.1	1020	-	-	-	-
Dioxane, 1,4-	123-91-1	No	602	1.91 x 10 ⁵	62.6	7.79	2180	11.2
Diphenylamine	122-39-4	No	501	838	-	-	-	-
Endosulfan	115-29-7	No	120	630	-	-	-	-
Endrin	72-20-8	No	6.02	3.67	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	20900	-	-	-
Ethylbenzene	100-41-4	No	2010	3810	2090	70.8	119	22.5
Ethylene Glycol	107-21-1	No	40100	5.69 x 10 ⁷	-	-	-	-
Fluoranthene	206-44-0	No	802	-	-	-	-	-
Fluorene	86-73-7	No	802	464	-	-	-	-
Formaldehyde	50-00-0	No	4010	3.17 x 10 ⁵	20.5	-	-	4.32
Heptachlor	76-44-8	No	10.0	1.47	-	0.173	0.0224	0.0432
Heptachlor Epoxide	1024-57-3	No	0.261	0.235	-	0.0856	0.0683	0.0216
Hexachlorobenzene	118-74-1	No	16.0	-	-	0.487	-	0.122
Hexachlorobutadiene	87-68-3	No	20.1	9.51	-	9.99	4.19	2.55
Hexachlorocyclohexane, Alpha-	319-84-6	No	160	246	-	0.124	0.168	-
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	0.433	0.588	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Hexachlorocyclohexane, Gamma-(Lindane)	58-89-9	No	6.02	9.24	-	0.708	0.962	-
Hexachlorocyclopentadiene	77-47-4	No	120	41.5	0.417	-	-	-
Hexachloroethane	67-72-1	No	14.0	13.7	62.6	19.5	16.7	5.10
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	60.2	7940	-	7.08	826	-
Hexane, N-	110-54-3	No	1200	638	1460	-	-	-
Hexanone, 2-	591-78-6	No	100	2750	62.6	-	-	-
Hydrazine ⁷	302-01-2	No	-	-	0.0626	0.260	1070	0.0115
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	0.343	-	-
Isophorone	78-59-1	No	4010	86300	-	820	15600	-
Isopropanol	67-63-0	No	40100	6.50 x 10 ⁶	417	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride ⁸	7487-94-7	No	6.02	95.4	-	-	-	-
Mercury (elemental)	7439-97-6	No	3.21	727	0.626	-	-	-
Methanol	67-56-1	No	40100	1.79 x 10 ⁷	41700	-	-	-
Methoxychlor	72-43-5	No	100	58.6	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	12000	1.46 x 10 ⁶	10400	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	1600	49000	6260	-	-	-
Methyl Mercury ⁷	22967-92-6	No	2.01	454	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	6260	433	19100	216
Methylene Chloride	75-09-2	Yes	120	3650	1250	125	3380	2030
Methylnaphthalene, 1-	90-12-0	No	1400	1120	-	26.9	18.9	-
Methylnaphthalene, 2-	91-57-6	No	80.2	64.9	-	-	-	-
Naphthalene	91-20-3	No	401	699	6.26	-	-	1.65
Nickel Soluble Salts	7440-02-0	No	401	18200	-	-	-	-
Nitrobenzene	98-95-3	No	40.1	622	18.8	-	-	1.40
Nitroglycerin	55-63-0	No	2.01	86.6	-	45.8	1750	-
Nitroguanidine	556-88-7	No	2010	1.81 x 10 ⁶	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.160	73.6	0.0834	0.00491	1.95	0.00145
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	0.111	3.39	-
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	159	501	-
Nitrotoluene, m-	99-08-1	No	2.01	13.6	-	-	-	-
Nitrotoluene, o-	88-72-2	No	18.0	154	-	3.54	26.7	-
Nitrotoluene, p-	99-99-0	No	80.2	615	-	48.7	330	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	1000	6.33 x 10 ⁵	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	201	-	-	-	-	-
Pentachlorophenol	87-86-5	No	100	29.3	-	1.95	0.502	-
Pentaerythritol tetranitrate (PETN)	78-11-5	No	40.1	960	-	195	4120	-
Perfluorooctane Sulphonic Acid (PFOS) ⁹	1763-23-1	No	0.602	-	-	-	-	-
Perfluorooctanoic Acid (PFOA) ¹⁰	335-67-1	No	0.401	-	-	11.1	-	-
Phenanthrene ²	85-01-8	No	602	246	-	-	-	-
Phenol	108-95-2	No	6020	1.40 x 10 ⁵	-	-	-	-
Phosphorus, White	7723-14-0	No	0.401	90.8	-	-	-	-
Polychlorinated Biphenyls (high risk)	1336-36-3	No	-	-	-	1.95	-	0.562
Propyl benzene	103-65-1	No	2010	1830	2090	-	-	-
Pyrene	129-00-0	No	602	151	-	-	-	-
Selenium	7782-49-2	No	100	22700	-	-	-	-
Silver	7440-22-4	No	100	1510	-	-	-	-
Styrene	100-42-5	No	4010	10200	2090	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	1.40 x 10 ⁻⁵	-	8.34 x 10 ⁻⁵	5.99 x 10 ⁻⁶	-	1.48 x 10 ⁻⁶

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic?	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Tetrachloroethane, 1,1,2,2-	79-34-5	No	401	3640	-	3.90	31.2	0.968
Tetrachloroethylene	127-18-4	No	120	230	83.4	371	626	216
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	40.1	2470	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.201	45.4	-	-	-	-
Toluene	108-88-3	No	1600	5290	10400	-	-	-
Toxaphene	8001-35-2	No	-	-	-	0.708	0.195	-
Tributyltin	56573-85-4	No	-	-	-	-	-	-
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	6.02 x 10 ⁵	1.91 x 10 ⁶	62600	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	16.0	12.5	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	201	164	4.17	26.9	19.4	-
Trichloroethane, 1,1,1-	71-55-6	No	40100	2.50 x 10 ⁵	10400	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	80.2	1250	0.417	13.7	188	3.51
Trichloroethylene	79-01-6	Yes	10.0	68.8	4.17	11.8	71.9	9.57
Trichlorofluoromethane	75-69-4	No	6020	36300	1460	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	2010	2880	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	20.1	30.1	-	70.8	94.1	-
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	201	872	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	160	362	-	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number ¹	Mutagenic ²	Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Trichloropropane, 1,2,3-	96-18-4	Yes	80.2	766	0.626	0.00835	0.0708	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	14.6	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	201	276	-	-	-	-
Tri-n-butyltin	688-73-3	No	6.02	9.85	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	602	46600	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	10.0	447	-	26.0	1020	-
Vanadium and Compounds	7440-62-2	No	101	595	-	-	-	-
Vinyl Acetate	108-05-4	No	20100	1.36 x 10 ⁶	417	-	-	-
Vinyl Chloride	75-01-4	Yes	60.2	891	209	0.214	2.74	3.35
Xylenes	1330-20-7	No	4010	7510	209	-	-	-
Zinc and Compounds	7440-66-6	No	6020	2.27 x 10 ⁶	-	-	-	-

¹ "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System

² Pyrene is a toxicity surrogate for acenaphthylene, benzo[*g,h,i*]perylene, and phenanthrene

³ The cleanup level for total chromium assumes 100% of a detected concentration is chromium VI

⁴ Cyanide expressed as free, or physiologically available cyanide

⁵ 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene

⁶ Diethylphthalate is a toxicity surrogate for dimethylphthalate

⁷ Chloromethane is a toxicity surrogate for hydrazine and methyl mercury (Kd value only)

⁸ Elemental mercury is a toxicity surrogate for mercuric chloride

⁹ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctane Sulfonate (PFOS)*

¹⁰ Toxicity is given in EPA's 2014 *Health Effects Document for Perfluorooctanoic Acid (PFOA)*

APPENDIX C: HIERARCHY OF TOXICITY SOURCES AND MCLS



Hierarchy of Toxicity Sources and MCLs

Alaska Department of Environmental Conservation

Division of Spill Prevention and Response

Contaminated Sites Program

Tier I Source = IRIS- Integrated Risk Information System

IRIS is EPA's data base containing qualitative and quantitative information on the human health effects that may result from exposure to chemical substances in the environment. The toxicity values listed in IRIS are considered to be validated and have undergone rigorous peer review. The completion of IRIS assessments is a multi-step process:

- 1) EPA Develops and Completes a draft IRIS Toxicological Review (Duration 345 Days)
- 2) Internal EPA Review (Duration 60 days)
- 3) EPA Initiates Interagency Science Consultation on Draft IRIS Toxicological Review (Duration 45 days)
- 4) EPA Initiates Independent External Peer Review of Draft IRIS Toxicological Review, Public Review and Comment on Draft IRIS Toxicological Review, and Holds a Public Listening Session (Duration 105 days)
- 5) EPA Revises IRIS Toxicological Review and Develops IRIS Summary (Duration 60 days)
- 6) (A) Internal EPA Review of Final IRIS Toxicological Review and IRIS Summary (Duration 45 days)
(B) EPA-led Interagency Science Discussion (Duration 45 days – concurrent with Step 6A.)
- 7) EPA Completion of IRIS Toxicological Review and IRIS Summary (Duration 30 days)

Tier II Source = PPRTV- Provisional Peer Reviewed Toxicity Values

The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by the EPA's Superfund program for use in site specific risk assessments. However, the PPRTVs are developed in a shorter period of time and although these assessments undergo external peer review, their development does not include Agency and interagency review as is done with the IRIS assessments. Furthermore, their development typically includes a limited evaluation of information on mode of action, other toxicological end points, and other information that provides a better understanding of the toxicology of these chemicals. Often, the amount of relevant information on the toxicity of these chemicals is less because fewer studies have been conducted and reported. However, the PPRTVs are generally the best quantification of the dose-response scientific data that is available at the time they are developed because the PPRTVs utilize current information and methodologies.

Tier III Source = Other Toxicity Values

Tier 3 includes additional EPA/non-EPA sources of toxicity information. Chemicals that have not been through a rigorous IRIS process or requested for PPRTV listing can contain toxicity recommend values from other sources. Priority should be given to sources of information that are most current, peer reviewed, transparent and publicly available. The quality of these values can vary widely and depends on the depth of the toxicity data base, the scientific quality and rigor of the underlying risk assessment and the scope of peer review. Some available values, such as Agency for

Toxic Substances and Disease Registry (ATSDR) Minimal Risk Level (MRLs) and California Environmental Protection Agency (Cal EPA) criteria, have undergone an extensive literature review, a rigorous data analysis using current guidance and methods to derive a toxicity value, and have been thoroughly peer reviewed. It should be noted that ATSDR MRLs are limited to non-cancer effects only. At the other end of the spectrum, there may be chemicals with no values and little or no available toxicity information, or outdated studies which are no longer consistent with current methodologies and practices.

Maximum Contaminant Levels (MCLs) are standards that are set by the United States EPA for drinking water quality. An MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act. To set a MCL for a contaminant, EPA first determines how much of the contaminant may be present with no adverse health effects based on the information from hierarchy of toxicity listed above. This level is called the Maximum Contaminant Level Goal (MCLG). MCLGs are non-enforceable public health goals. The legally enforced MCL is then set as close as possible to the MCLG. The MCL for a contaminant may be higher than the MCLG because of difficulties in measuring small quantities of a contaminant, a lack of available treatment technologies, or if EPA determines that the costs of treatment would outweigh the public health benefits of a lower MCL. In the last case, EPA will set the MCL to balance the cost of treatment with the public health benefits.

The EPA guidance for establishing an MCL states that "MCLs are enforceable standards and are to be set as close to the maximum contaminant level goals (MCLGs) (Health Goals) as is feasible and are based upon treatment technologies, costs (affordability) and other feasibility factors, such as availability of analytical methods, treatment technology and costs for achieving various levels of removal." The process of determining an MCL only starts with an evaluation of the adverse effects caused by the chemical in question and the doses needed to cause such effects. Finally, only a very small percentage of environmental contaminants have an established MCL.