SUBCHAPTER D: DEVELOPMENT OF PROTECTIVE CONCENTRATION LEVELS
§§350.71 - 350.79
Effective March 19, 2009

§350.71. General Requirements.

(a) This subchapter describes separate tiered processes for establishing protective concentration levels of COCs that can remain in the source medium and be protective of human and ecological receptors at the point of exposure within the exposure medium. The tiered process for the calculation of human health protective concentration levels (PCLs) is set forth in §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) and is structured conceptually in terms of Tiers 1, 2, and 3. Each tier sets forth conditions to calculate PCLs and each successive tier incrementally provides for more consideration of site-specificity and sophistication in the PCL calculation process. The person can move through the tiered process or start at any tier, but must conduct the cumulative check in accordance with §350.72(b) of this title (relating to Carcinogenic Risk Levels and Hazard Indices for Human Health Exposure Pathways). The human health PCLs under Tiers 1, 2 and 3 are set based on the receptors and exposure pathways as specified in subsections (b) and (c) of this section in consideration of the land use classification of the affected property, the classification of groundwater, the distribution of COCs in environmental media, and the presence of receptors. The tiered process for ecological evaluations is different. Tier 1 is an exclusion criteria checklist that is used to exclude sites which do not pose potential ecological risk from further evaluation. If a site is not excluded from Tier 1, then the person must further evaluate the site for ecological risk, and possibly establish ecological PCLs are under Tiers 2 or 3. The lowest of the human health and any applicable ecological PCLs determined for each COC for the soil, groundwater, surface water, sediment, or air as required, and are then respectively compared with representative concentrations of COCs in the soil, groundwater, surface water, sediment, or air as appropriate to determine if the PCLs are exceeded or not. If PCLs are exceeded for certain COCs, then PCLs may be further evaluated under the respective tiered process and compared again to representative site concentrations to determine if further action is needed; otherwise a response action must be initiated. No further action is required for those COCs which do not exceed the PCLs, and the cumulative criteria of §350.72(b) of this title.

(b) The person shall:

(1) ensure PCLs are protective of human health and the environment;

(2) determine human health PCLs based on residential or commercial/industrial exposure as appropriate for the land use of each affected on-site and off-site property;

(3) assume the human receptor is a resident for residential property; and

(4) assume the human receptor is a commercial/industrial worker for commercial/industrial property.

(c) The person shall develop PCLs for each of the following human health exposure pathways which are complete or reasonably anticipated to be completed based on the provided criteria.

(1) Ingestion of COCs in class 1 or 2 groundwater. The person shall consider the ingestion of COCs in class 1 or 2 groundwater to be a complete or reasonably anticipated to be completed exposure pathway when class 1 or 2 groundwater is affected.

(2) COCs in class 3 groundwater. The person shall establish PCLs for class 3 groundwater as necessary to protect human health and safety, and the environment, and to comply with the groundwater response objectives in accordance with Subchapter B of this chapter (relating to Remedy Standards).

(3) Inhalation of volatile emissions in outdoor air from COCs in groundwater-bearing units. The person shall at a minimum consider this to be a complete or reasonably anticipated to be completed exposure pathway when a plume management zone is established in accordance with §350.33(f) of this title (relating to Remedy Standard B) unless the person:

(A) demonstrates with representative and appropriate vapor monitoring data or other technically appropriate method that volatile emissions from groundwater are protective; or

(B) otherwise demonstrates that the pathway is incomplete at the affected property. A competent, existing physical control which prevents the release of COCs from groundwater into air above the PCLs may be considered in accordance with subsection (d) of this section.

(4) Combined inhalation of volatile emissions and particulates from COCs in surface soil, dermal contact with COCs in surface soil, ingestion of COCs in surface soil, and for affected residential properties, ingestion of above and below-ground vegetables grown in surface soils containing COCs. Other than within a waste control unit, the person shall consider this combined exposure pathway to be a complete or reasonably anticipated to be completed exposure pathway; however, competent existing physical controls may be considered in accordance with subsection (d) of this section.

(5) Leaching of COCs in surface and subsurface soils to groundwater. The person shall consider this to be a complete or reasonably anticipated to be completed exposure pathway; however, a competent existing physical control which prevents the release of COCs from soils to groundwater above the PCLs may be considered in accordance with subsection (d) of this section.

(6) Inhalation of volatile emissions from COCs in subsurface soils. Other than below a waste control unit, the person shall consider this to be a complete or reasonably anticipated to be completed exposure pathway unless the person demonstrates with representative and appropriate vapor monitoring data, or other technically appropriate method that the exposure pathway is incomplete. A competent existing physical control which prevents the release of COCs from subsurface soils to air above the PCLs may be considered in accordance with subsection (d) of this section.

(7) Contact with surface water or sediment containing COCs originating from the source area. The person shall evaluate this exposure pathway to determine if it is a complete or reasonably anticipated to be completed exposure pathway when a COC has been discharged or will discharge to a surface water body or sediment.

(8) Other complete or reasonably anticipated to be completed exposure pathways. The person shall reasonably evaluate other potentially applicable exposure pathways and identify the ones which are complete or are reasonably anticipated to be completed.

(d) In accordance with subsection (c)(3) - (6) of this section, and §350.77 of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels), the presence of a competent existing physical control which prevents the exposure of receptors to COCs may be considered as sufficient proof that the exposure pathway is incomplete for the geographic area covered by the control when the person is able and willing to incorporate that physical control as a Remedy Standard B response action meeting all associated performance, institutional control, and post-response action care requirements, including financial assurance, for that physical control. The existing physical control shall not be considered to be a remedy for or remove the exposure pathway from consideration for the geographic area which extends beyond the existing limits of the competent existing physical control. Consideration of physical controls during the exposure pathway analysis does not negate or otherwise supercede the soil or groundwater response objectives as set forth in Subchapter B of this chapter (relating to Remedy Standards).

(e) The person shall establish the human health POE(s) for each environmental media in accordance with §350.37 of this title (relating to Human Health Points of Exposure). Consideration of physical controls during the exposure pathway analysis does not negate or otherwise supercede the POE criteria of §350.37 of this title.

(f) The person shall establish the risk-based exposure limits in accordance with §350.74 of this title (relating to Development of Risk-Based Exposure Limits) when establishing PCLs.

(g) For COCs which have both carcinogenic and noncarcinogenic effects for an exposure pathway, the person shall establish separate PCLs for both carcinogenic and noncarcinogenic effects for the individual and combined exposure pathways. The person shall then use the lower of the carcinogenic or noncarcinogenic PCL for that COC and exposure pathway.

(h) The person shall ensure that PCLs developed are protective for both on-site and off-site human receptors at the carcinogenic risk levels and hazard quotient and index as specified in §350.72 of this title (relating to Carcinogenic Risk Levels and Hazard Indices for Human Health Exposure Pathways), as well as for applicable ecological receptors.

(i) The person shall establish critical PCLs in accordance with §350.78 of this title (relating to Determination of Critical Protective Concentration Levels).

(j) The person is not required to combine exposure pathways across source media (e.g., soil exposure pathways combined with groundwater exposure pathways) unless the executive director determines such combination is necessary to address actual situations where receptors are simultaneously exposed to COCs present in multiple source media.

(k) For Tiers 1, 2, and 3 as explained in §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) and §350.77 of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels), the person shall establish PCLs for each individual COC within each environmental medium unless the conditions of paragraphs

(1), (2), (3), or (4) of this subsection are met or unless the use of paragraphs (1), (2), (3), or (4) of this subsection is prohibited by the individual program area listed in §350.2 of this title (relating to Applicability). For the purposes of determining whether a COC meets the conditions of paragraphs (1), (2), (3), or (4) of this subsection, a COC should be considered detected in a particular environmental medium if the analytical measurement is greater than the method detection limit and the analytical response meets the qualitative identification criteria recommended in the analytical method.

(1) The COC is detected in at least one sample, but all detected COC concentrations and sample detection limits for the COC are less than the residential assessment level in the environmental medium being evaluated under this paragraph, as well as in all other environmental media from which samples were collected.

(2) The COC is detected in at least one sample in the environmental medium, but the conditions described in one of subparagraphs (A) - (E) of this paragraph are met and all nondetected results for the COC are less than the residential assessment level in the environmental medium being evaluated under this paragraph.

(A) The COC meets all of the conditions in the following clauses (i) - (iii) of this subparagraph:

(i) twenty or more representative samples analyzed for that COC have been collected from the environmental medium evaluated under this subparagraph;

(ii) the COC is detected in less than 5% of the twenty or more samples required in clause (i) of this subparagraph; and

(iii) the executive director determines that a PCL is not warranted for the COC in order to protect human health and the environment in consideration of, but not limited to, the concentration and distribution of the COC in environmental media, source area information, knowledge of on-site historical operations, characteristics of the COC and the affected property, and companion and daughter product relationships to the COC.

(B) The COC is a common laboratory contaminant (i.e., methylene chloride, acetone, toluene, 2-butanone (methyl ethyl ketone), dimethyl phthalate, diethyl phthalate, di-n-butyl phthalate, butylbenzyl phthalate, bis (2-ethylhexyl) phthalate, and di-n-octyl phthalate**)**, and the concentration of the COC detected in each sample for that environmental medium does not exceed 10 times the maximum amount detected in any associated blank, and the COC is not anticipated to be present based on knowledge of on-site historical operations including consideration of companion and daughter products.

(C) The COC is not a common laboratory contaminant, as defined in subparagraph (B) of this paragraph, and the concentration of the COC detected in each sample for that environmental medium does not exceed five times the maximum amount detected in any associated blank, and the COC is not anticipated to be present based on knowledge of on-site historical operations including consideration of companion and daughter products.

(D) The maximum concentration of the COC detected at the affected property does not exceed the property-specific or Texas-specific background concentration as specified in Figure:

30 TAC §350.51(m). For the purpose of determining whether the COC meets the conditions of this paragraph, the person shall consider the maximum concentration of the COC to be the higher of the maximum detected concentration or the appropriate proxy value as determined in accordance with §350.51(n) of this title (relating to Affected Property Assessment).

(E) The person sufficiently demonstrates that the release of COCs did not result from activity at the on-site property based on appropriate evidence, including, but not limited to, the concentration and distribution of the COC in environmental media, source area information, consideration of companion and daughter products, and knowledge of on-site historical operations.

(3) The COC is known or is reasonably anticipated to be associated with historical or current activities conducted at the on-site property, but the COC is not detected in any sample in the environmental medium, and all sample detection limits for the COC are less than the residential assessment level for the environmental medium.

(4) The COC is not known or is not reasonably anticipated to be associated with historical or current activities conducted at the on-site property, and is not detected in any sample in the environmental medium.

Adopted February 21, 2007 Effective March 19, 2007

§350.72. Carcinogenic Risk Levels and Hazard Indices for Human Health Exposure Pathways.

(a) The person shall base the RBELs developed in accordance with §350.74 of this title (relating to Development of Risk-Based Exposure Limits) and the PCLs developed in accordance with §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) on the following carcinogenic risk level and hazard quotient.

(1) Carcinogenic COCs. The RBEL and PCL for each carcinogenic COC, including those PCLs based on combined exposure pathways, shall be based on a carcinogenic risk level of 1×10^{-5} (1 in 100,000) except when other standards shall be used as RBELs as discussed in §350.74 of this title (relating to Development of Risk-Based Exposure Limits).

(2) Noncarcinogenic COCs. The RBEL and PCL for each noncarcinogenic COC, including those PCLs based on combined exposure pathways, shall be based on a hazard quotient of 1 except when other standards shall be used as RBELs as discussed in §350.74 of this title (relating to Development of Risk-Based Exposure Limits).

(b) The person shall evaluate whether the PCLs for a human health exposure pathway need to be adjusted to lower concentrations to meet the cumulative carcinogenic risk level and hazard index criteria in subsection (c) of this section when there are more than 10 carcinogenic COCs and/or more than 10 noncarcinogenic COCs within a source medium. The person shall conduct this evaluation separately for each individual and combined human health exposure pathway for which PCLs must be developed in accordance with §350.71(c) of this title (relating to General Requirements). This cumulative evaluation shall include all COCs across all tiers for which the person is required to establish PCLs in accordance with §350.71(k) of this title. In cases where 10 or more carcinogenic COCs and 10 or more noncarcinogenic COCs are present in the source medium, the cumulative evaluation shall be conducted

for both carcinogenic COCs and noncarcinogenic COCs by separately addressing the cumulative effects of multiple carcinogenic COCs and multiple noncarcinogenic COCs. The COCs which exhibit both carcinogenic and noncarcinogenic characteristics shall be counted as both a carcinogenic COC and a noncarcinogenic COC and evaluated as required by this subsection. This evaluation shall be modified as specified in paragraphs (1)-(5) of this subsection.

(1) For the groundwater ingestion exposure pathway, the person shall not include COCs with a primary maximum contaminant level (MCL) as provided in 40 Code of Federal Regulations Part 141, as amended, or the most currently available federal action level for drinking water (e.g., lead and copper) in the cumulative carcinogenic risk level or hazard index evaluation when that MCL or action level is the groundwater ingestion PCL. The person is also not required to include COCs with a secondary MCL as provided in 40 Code of Federal Regulations Part 143, as amended, in the cumulative carcinogenic risk level or hazard index evaluation when the secondary MCL is used as the groundwater PCL and is based on a RBEL established in accordance with §350.74(f)(3) of this title (relating to Development of Risk-Based Exposure Limits) for that COC.

(2) The person is not required to comply with subsection (c) of this section for the class 3 groundwater PCL $^{GW}GW_{Class\ 3}$.

(3) The person is not required to conduct an additional cumulative check in accordance with subsection (c) of this section for the soil-to-groundwater PCL ^{GW}Soil. The cumulative check is already addressed when establishing ^{GW}Soil to meet the groundwater PCLs which have been adjusted to comply with the criteria specified in subsection (c) of this section.

(4) The person is not required to comply with subsection (c) of this section for the groundwater-to-surface water PCL ^{SW}GW.

(5) The person shall not include the PCL established in §350.76 of this title (relating to Approaches for Specific Chemicals of Concern to Determine Human Health Protective Concentration Levels) for lead, dioxins, or polychlorinated biphenyls (only exclude polychlorinated biphenyls when the soil PCL is based on requirements of the Toxic Substances Control Act as specified in §350.76(d)(4) of this title) in soil in the cumulative carcinogenic and hazard index evaluation.

(c) The person shall use the following criteria for the cumulative carcinogenic risk level and hazard index when determining if the evaluation in subsection (b) of this section requires PCLs for individual COCs to be adjusted to a lower concentration.

(1) Carcinogenic COCs. The cumulative carcinogenic risk level for multiple carcinogenic COCs shall not exceed 1×10^{-4}.

(2) Noncarcinogenic COCs. The hazard index for multiple noncarcinogenic COCs shall not exceed 10.

(d) The person shall use the equation in the following figure to adjust PCLs to a lower concentration as required in subsection (b) of this section to achieve the cumulative carcinogenic risk level or hazard index established in subsection (c) of this section. The person shall adjust the PCL for one or more COCs to a lower concentration (carcinogens and noncarcinogens are treated separately) such that

the conditions of the equation are met. The person shall choose which PCLs are adjusted downward and the magnitude of the reduction. The PCL_i shall remain constant in the denominator. The PCL-adj_i, which is the final human health PCL for a particular COC and exposure pathway, shall be less than or equal to PCL_i.

Figure: 30 TAC §350.72(d):

$$10 \geq \frac{PCL\text{-}adj_1}{PCL_1} + \frac{PCL\text{-}adj_2}{PCL_2} + \ldots + \frac{PCL\text{-}adj_i}{PCL_i}$$

where:

$$10 = \frac{RL_{cum}}{RL} \text{ or } \frac{HI}{HQ}$$

where:

(1) RL_{cum} = the cumulative carcinogenic risk level for multiple carcinogenic COCs (i.e., 10^{-4});

(2) RL = the carcinogenic risk level for a single carcinogenic COC (i.e., 10^{-5});

(3) HI = the hazard index for multiple noncarcinogenic COCs (i.e., 10);

(4) HQ = the hazard quotient for a single noncarcinogenic COC (i.e., 1);

(5) PCL-adj_i = PCL for COC "i" adjusted for cumulative effects associated with multiple COCs (mg/kg or mg/l); and

(6) PCL_i = PCL for individual exposure pathways or combined exposure pathways for COC "i" (mg/kg or mg/l).

Adopted September 2, 1999 Effective September 23, 1999

§350.73. Determination and Use of Human Toxicity Factors and Chemical Properties.

(a) In all cases, the toxicity factors used must be protective of human health and the environment. The person shall use the chronic human toxicity factors taken from the following hierarchy of sources (unless otherwise specified in §350.76 of this title (relating to Approaches for Specific Chemicals of Concern to Determine Human Health Protective Concentration Levels)) unless the specific provision contained in subsection (b) of this section applies. The person shall use the source in paragraph (1) of this subsection and only if the relevant chronic human toxicity factor is not available in that source, proceed to the source in paragraph (2) of this section and, only if the toxicity factor is not available in that source,

proceed in the same fashion through sources in paragraphs (3) – (7) of this subsection. The chronic human toxicity factors, in order of hierarchy of sources in paragraphs (1) - (7) of this subsection, which are most current as of the submittal date of the SIN or the RAP are presumed to be protective of human health and the environment, unless a person rebuts this presumption by published credible authority. In addition, the executive director may determine during review of the RACR that a change in a toxicity factor since the submittal of the SIN or RAP has been of such a magnitude that the PCLs previously developed for a COC would clearly not be protective of human health and the environment, then the adequacy of the response action must be reevaluated. Likewise, if the executive director determines at any time that a subsequent change in a toxicity factor is of such a magnitude such that the proposed response action is no longer warranted to protect human health and the environment, then a response action based on that previous chronic toxicity factor consideration shall no longer be required.

(1) United States Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS);

(2) EPA Provisional Peer Reviewed Toxicity Values (i.e., Superfund Health Risk Technical Support Center;

(3) EPA Health Effects Assessment Summary Tables;

(4) EPA National Center for Environmental Assessment (i.e., Superfund Technical Support Center);

(5) the TCEQ Chronic Remediation-Specific Effects Screening Levels;

(6) Agency for Toxic Substances and Disease Registry; and

(7) other scientifically valid sources as approved by the executive director.

(b) The executive director may direct a person to use a chronic human toxicity factor from a source other than that selected in accordance with the source hierarchy list provided in subsection (a) of this section in cases where the executive director has determined it to be necessary to use a more scientifically valid chronic human toxicity factor than that from the source identified in accordance with subsection (a) of this section.

(c) If the executive director determines that it is necessary to evaluate COCs which do not have any human chronic toxicity factors provided in the sources listed in subsection (a) of this section, then the executive director will provide chronic toxicity factors. The person may provide toxicological information to the executive director for consideration in the derivation of the chronic toxicity factors. The person shall provide all toxicological data from any toxicological studies conducted for the person when such information is requested by the executive director. The person shall use the TCEQ Chronic Remediation-Specific Effects Screening Level value as the reference concentration in evaluating the inhalation pathway for both residential and commercial/industrial land use in accordance with §350.75(i)(3), (6) and (8) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), and all chronic inhalation exposure pathways for which PCLs are established in accordance with §350.75(i)(5) and (11) of this title, but only in cases where neither an EPA unit risk factor nor an EPA reference concentration is available for that COC from the hierarchy list provided in subsection (a)

of this section, and the executive director has not directed the person to use a toxicity factor in accordance with subsection (b) of this section.

(d) Unless prior approval is provided by the executive director in accordance with §350.74(j)(2) of this title (relating to Development of Risk-Based Exposure Limits) to use a subchronic exposure duration (i.e., <seven years) for a commercial/industrial property, the person shall not use subchronic toxicity factors.

(e) In the situation where different reference doses have been established for a COC based on water ingestion and food consumption, the person shall use the reference dose for water ingestion for the water ingestion exposure pathway and the reference dose for food consumption for all soil exposure pathways.

(f) The person shall use the COC chemical/physical parameter values for COCs provided in the following figure to calculate PCLs, unless the executive director approves the use of a more representative alternative value in accordance with paragraphs (1) and (2) of this subsection. For those COCs not included in the figure in this subsection, the person may provide chemical/physical information to the executive director for consideration in developing appropriate chemical/physical parameters.

Chemical/Physical Properties of COCs (Legend on last page of Table)

	COMPOUND	Phys-ical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	LogK_{oc}	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
1	Acenaphthene	s	83-32-9	O	154.21	6.44E-03	3.60	------	4.21E-02	7.69E-06	4.24E+00	3.75E-03	4.15		
2	Acenaphthylene	s	208-96-8	O	152.20	4.74E-03	3.84	------	4.39E-02	7.07E-06	3.93E+00	2.90E-02	3.94		
3	Acetaldehyde	g	75-07-0	O	44.05	2.75E-03	*0.42*	------	1.24E-01	1.23E-05	1.00E+06	9.00E+02	0.43		
4	Acetone	l	67-64-1	O	58.08	1.61E-03	-0.24	------	1.24E-01	1.14E-05	6.00E+05	2.27E+02	-0.24		
5	Acetone cyanohydrin	l	75-86-5	O	85.11	1.34E-04	*-0.22*	------	8.12E-02	9.09E-06	1.83E+06	8.00E-01	-0.03		
6	Acetonitrile	l	75-05-8	O	41.05	1.21E-03	-0.33	------	1.28E-01	1.45E-05	2.05E+05	9.00E+01	-0.34		
7	Acetophenone	l	98-86-2	O	120.15	4.45E-04	1.56	------	6.00E-02	8.73E-06	5.50E+03	3.95E-01	1.67		
8	Acifluorfen, sodium	s	62476-59-9	O	383.64	*< 8.31E-13*	2.05	------	1.45E-02	4.40E-06	> 2.50E+05	< 9.75E-09	0.37		
9	Acrolein	l	107-02-8	O	56.06	1.83E-04	-0.28	------	1.05E-01	1.12E-05	2.00E+05	2.65E+02	-0.10		
10	Acrylamide	s	79-06-1	O	71.08	1.33E-08	-0.66	------	9.70E-02	1.28E-05	2.20E+06	7.00E-03	-0.81		
11	Acrylic acid	l	79-10-7	O	72.06	1.32E-05	*0.05*	------	9.08E-02	1.06E-05	1.00E+06	3.72E+00	0.44		
12	Acrylonitrile	l	107-13-1	O	53.06	4.57E-03	0.04	------	1.22E-01	1.34E-05	7.50E+04	1.10E+02	0.21		
13	Alachlor	s	15972-60-8	O	269.77	8.62E-07	2.28	------	1.94E-02	5.83E-06	2.40E+02	2.20E-05	3.37		
14	Aldicarb	s	116-06-3	O	190.27	5.82E-08	1.20	------	3.05E-02	7.20E-06	6.00E+03	2.90E-05	1.36		
15	Aldicarb sulfone	s	1646-88-4	O	222.27	1.10E-07	0.23	------	*5.55E-02*	*5.79E-06*	8.00E+03	9.00E-05	-0.67		
16	Aldrin	s	309-00-2	O	364.91	7.07E-03	4.68	------	1.32E-02	4.86E-06	7.84E-02	1.67E-05	6.75		
17	Allyl alcohol	l	107-18-6	O	58.08	2.08E-04	0.51	------	1.14E-01	1.10E-05	3.20E+05	2.63E+01	0.17		
18	Allyl chloride	l	107-05-1	O	76.53	4.57E-01	1.43	------	9.80E-02	1.08E-05	3.40E+03	3.60E+02	1.93		
19	Aluminum	s	7429-90-5	M	26.98	*0.00E+00*		2.55	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	0.33	1.5E-03	6.50E-04
20	Aminopyridine, 4-	s	504-24-5	O	94.12	2.44E-07	-0.32	------	8.02E-02	1.08E-05	7.66E+04	2.00E-03	-0.11		
21	Ammonia	g	7664-41-7	I	17.03	1.36E-02	0.49	------	2.59E-01	6.93E-05	5.31E+05	7.47E+03	0.23		
22	Ammonium sulfamate	s	7773-06-0	I	114.13	*0.00E+00*	--------	CE	*9.81E-02*	*1.04E-05*	2.00E+06	0.00E+00	-4.34		
23	Aniline	l	62-53-3	O	93.13	5.82E-05	0.96	------	7.00E-02	8.30E-06	3.60E+04	6.69E-01	1.08		
24	Anthracene	s	120-12-7	O	178.23	4.61E-03	4.37	------	3.24E-02	7.74E-06	4.34E-02	2.55E-05	4.35		
25	Antimony		7440-36-0	M	121.75	0.00E+00	--------	1.65	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	7.0E-02	3.00E-02
26	Aramite	l	140-57-8	O	334.86	CE	*4.00*	------	*4.23E-02*	*4.45E-06*	CE	1.23E-04	4.82		
27	Aroclor 1016	l	12674-11-2	O	257.55	2.27E-02	4.87	------	2.05E-02	6.80E-06	4.20E-01	7.12E-04	5.69		
28	Aroclor 1254	L	11097-69-1	O	327.00	1.12E-01	5.72	------	CE	5.60E-06	3.45E-02	8.82E-05	5.61		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
29	Arsenic	s	7440-38-2	M	74.92	0.00E+00	--------	1.40	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	0.68	1.00E-02	8.00E-03
30	Arsine	g	7784-42-1	I	77.95	*2.41E-01*	--------	CE	CE	CE	2.00E+05	1.13E+04	CE		
31	Asbestos	s	1332-21-4	I	varies	0.00E+00	--------	5.00	CE	CE	0.00E+00	0.00E+00	CE		
32	Atrazine	s	1912-24-9	O	215.69	1.09E-07	2.20	------	*5.64E-02*	*5.58E-06*	3.00E+01	3.00E-07	2.82		
33	Barium	s	7440-39-3	M	137.33	0.00E+00	--------	1.04	*0.00E+00*	*0.00E+00*	0.00E+00	*0.00E+00*	*0.00*	4.9E-02	1.50E-02
34	Barium cyanide	s	542-62-1	I	189.37	CE	--------	1.78	CE	CE	8.00E+05	CE	CE	4.9E-02	1.50E-02
35	Benzene	l	71-43-2	O	78.11	2.27E-01	1.82	------	8.80E-02	9.80E-06	1.77E+03	9.50E+01	1.99		
36	Benzenethiol	l	108-98-5	O	110.18	1.83E-02	1.32	------	7.60E-02	*8.68E-06*	7.60E+02	2.40E+00	2.69		
37	Benzidine	s	92-87-5	O	184.24	1.62E-09	1.32	------	*3.40E-02*	1.50E-05	5.20E+02	8.36E-08	1.34		
38	Benzo-a-anthracene	s	56-55-3	O	228.29	1.39E-04	5.55	------	5.10E-02	9.00E-06	1.00E-02	1.54E-07	5.52		
39	Benzo-a-pyrene	s	50-32-8	O	252.32	4.70E-05	5.98	------	4.30E-02	9.00E-06	1.62E-03	4.89E-09	6.11		
40	Benzo-b-fluoranthene	s	205-99-2	O	252.32	4.99E-04	6.08	------	2.26E-02	5.56E-06	1.50E-03	8.06E-08	6.11		
41	Benzo-j-fluoranthene	s	205-82-3	O	252.32	*4.63E-04*	*5.72*	------	*4.15E-02*	*5.48E-06*	2.50E-03	*8.39E-08*	6.11		
42	Benzo-k-fluoranthene	s	207-08-9	O	252.32	4.45E-07	6.09	------	2.26E-02	5.56E-06	5.50E-04	9.59E-11	6.11		
43	Benzo-(g,h,i)-perylene	s	191-24-2	O	276.34	5.82E-06	6.20	------	4.90E-02	5.65E-05	2.60E-04	1.00E-10	6.70		
44	Benzoic acid	s	65-85-0	OA	122.12	1.39E-05	-0.30	------	5.36E-02	7.97E-06	3.50E+03	6.51E-03	1.87		
45	Benzotrichloride	l	98-07-7	O	195.48	*2.03E-02*	3.16	------	5.91E-02	7.02E-06	1.00E+02	1.90E-01	3.90		
46	Benzyl alcohol	l	100-51-6	O	108.14	1.62E-05	1.08	------	8.00E-02	8.00E-06	4.00E+04	1.06E-01	1.08		
47	Benzyl chloride	l	100-44-7	O	126.59	1.66E-02	2.26	------	7.50E-02	7.80E-06	4.93E+02	1.20E+00	2.79		
48	Beryllium	s	7440-41-7	M	9.01	0.00E+00	--------	1.36	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	0.57	3.60E-03	1.50E-03
49	Biphenyl, 1,1-	s	92-52-4	O	154.21	1.25E-02	3.71	------	5.73E-02	6.71E-06	7.50E+00	2.94E-02	3.76		
50	Bis (2-chloro-ethyl) ether	l	111-44-4	O	143.01	8.90E-04	1.19	------	6.92E-02	7.53E-06	1.02E+04	1.34E+00	1.56		
51	Bis (2-chloroisopropyl) ether	l	108-60-1	O	171.07	4.16E-03	2.50	------	6.00E-02	6.40E-06	1.70E+03	8.50E-01	2.58		
52	Bis (2-chloromethyl) ether	l	542-88-1	O	114.96	4.99E-03	0.08	------	*8.32E-02*	*9.59E-06*	3.80E+04	3.00E+01	0.58		
53	Bis (2-ethyl-hexyl) phthalate	l	117-81-7	O	390.56	4.57E-04	5.83	------	3.51E-02	3.66E-06	3.00E-01	6.45E-06	8.39		

	COMPOUND	Phys-ical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
54	Bis (tri-n-butyltin) oxide	l	56-35-9	O	596.11	2.08E-03	CE	------	CE	CE	1.80E+01	*6.91E-05*	5.80		
55	Bromodichloromethane	l	75-27-4	O	163.83	1.32E-01	1.74	------	2.98E-02	1.06E-05	4.50E+03	5.84E+01	1.61		
56	Bromoform	l	75-25-2	O	252.73	2.56E-02	1.94	------	1.49E-02	1.03E-05	3.20E+03	5.60E+00	1.79		
57	Bromomethane	g	74-83-9	O	94.94	5.90E-01	1.02	------	7.28E-02	1.21E-05	1.52E+04	1.64E+03	1.18		
58	Butadiene, 1,3-	g	106-99-0	O	54.09	2.61E+00	2.11	------	1.79E-01	1.02E-05	7.35E+02	2.11E+03	2.03		
59	Butanol, n-	l	71-36-3	O	74.12	3.55E-04	0.77	------	8.00E-02	9.30E-06	7.47E+04	6.54E+00	0.84		
60	Butylate	l	2008-41-5	O	217.38	3.50E-03	2.10	------	*4.89E-02*	*5.14E-06*	4.60E+01	1.30E-02	3.85		
61	Butyl benzyl phthalate	l	85-68-7	O	312.37	7.94E-05	4.14	------	1.74E-02	4.83E-06	2.90E+00	1.20E-05	4.84		
62	Cacodylic acid	s	75-60-5	O	138.00	*0.00E+00*	0.38	------	CE	CE	2.00E+06	0.00E+00	0.00		
63	Cadmium	s	7440-43-9	M	112.41	0.00E+00	--------	1.18	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	-0.07	1.40E-01	6.40E-02
64	Calcium cyanide	s	592-01-8	I	92.11	CE	--------	CE	CE	CE	CE	CE	-2.41		
65	Captan	s	133-06-2	O	300.59	2.99E-04	3.81	------	1.83E-02	4.90E-06	5.00E-01	7.50E-06	1.84		
66	Carbaryl	s	63-25-2	O	201.22	5.32E-07	2.37	------	2.78E-02	5.60E-06	3.00E+01	1.36E-06	2.35		
67	Carbazole	s	86-74-8	O	167.21	3.38E-03	3.39	------	3.90E-02	7.03E-06	7.21E-01	2.66E-04	3.23		
68	Carbofuran	s	1563-66-2	O	221.26	1.62E-07	1.46	------	5.35E-02	5.40E-06	7.00E+02	8.30E-06	2.30		
69	Carbosulfan	l	55285-14-8	O	380.55	*2.15E-05*	*4.41*	------	*3.76E-02*	*3.88E-06*	3.00E-01	3.10E-07	5.57		
70	Carbon disulfide	l	75-15-0	O	76.14	6.13E-01	1.72	------	1.04E-01	1.00E-05	2.30E+03	3.40E+02	1.94		
71	Carbon tetrachloride	l	56-23-5	O	153.82	1.20E+00	2.27	------	7.80E-02	8.80E-06	8.05E+02	1.12E+02	2.44		
72	Chloral	l	75-87-6	O	147.39	2.66E-05	*0.80*	------	3.85E-02	9.70E-06	8.30E+06	3.50E+01	1.19		
73	Chlordane	s	57-74-9	O	409.78	2.02E-03	5.08	------	1.18E-02	4.37E-06	5.60E-02	1.00E-05	6.60		
74	Chlorfenvinphos	l	470-90-6	O	359.57	*2.31E-08*	3.11	------	CE	CE	1.45E+02	1.70E-07	4.15		
75	Chlorine	g	7782-50-5	I	70.91	*2.86E+00*	--------	CE	*1.20E-01*	*1.48E-05*	7.00E+03	5.17E+03	0.85		
76	Chlorine cyanide	g	506-77-4	O	61.47	*1.12E-01*	--------	CE	*1.20E-01*	*1.39E-05*	3.00E+04	1.00E+03	-0.38		
77	Chloroanaline, p-	s	106-47-8	O	127.57	4.86E-05	1.82	------	4.83E-02	1.01E-05	3.90E+03	2.35E-02	1.72		
78	Chlorobenzene	l	108-90-7	O	112.56	1.82E-01	2.33	------	7.30E-02	8.70E-06	5.02E+02	1.21E+01	2.64		
79	Chlorobenzilate	s	510-15-6	O	325.19	3.78E-06	2.90	------	8.00E-02	8.00E-06	1.30E+01	2.20E-06	3.99		
80	Chloro-1,3-butadiene, 2-	l	126-99-8	O	88.54	1.33E+00	2.00	------	1.00E-01	1.00E-05	6.30E+02	2.12E+02	2.53		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
81	Chlorodifluoromethane	g	75-45-6	O	86.47	1.22E+00	*0.79*	------	1.13E-01	1.32E-05	2.90E+03	7.83E+03	0.89		
82	Chloroethane	l	75-00-3	O	64.51	2.12E-01	1.25	------	1.50E-01	1.18E-05	2.00E+04	1.20E+03	1.58		
83	Chloroform	l	67-66-3	O	119.38	1.53E-01	1.67	------	1.04E-01	1.00E-05	7.92E+03	1.98E+02	1.52		
84	Chloromethane	g	74-87-3	O	50.49	1.44E+00	0.78	------	1.26E-01	6.50E-06	7.25E+03	3.77E+03	1.09		
85	Chloronaphthalene, 2-	s	91-58-7	O	162.62	2.54E-02	3.93	------	6.18E-02	6.98E-06	6.74E+00	1.70E-02	3.81		
86	Chlorophenol, 2-	l	95-57-8	OA	128.56	7.40E-04	2.46	------	5.01E-02	9.46E-06	2.80E+04	1.42E+00	2.16		
87	Chlorotoluene, 2-	l	95-49-8	O	126.59	1.35E-01	2.61	------	7.01E-02	--------	1.54E+02	3.9E-03	3.20		
88	Chlorpyrifos	s	2921-88-2	O	350.59	1.73E-04	3.70	------	*4.85E-02*	*5.11E-06*	9.00E-01	1.87E-05	4.66		
89	Chromium (III)/Chromium (total)	s	7440-47-3	M	52.00	0.00E+00	--------	3.08	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	5.20E-03	4.50E-03
90	Chromium (VI)	s	18540-29-9	M	52.00	0.00E+00	--------	1.15	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	5.20E-03	4.50E-03
91	Chrysene	s	218-01-9	O	228.29	5.03E-05	5.49	--------	2.48E-02	6.21E-06	2.00E-03	7.80E-09	5.52		
92	Cobalt	s	7440-48-4	M	58.93	*0.00E+00*	--------	1.65	*0.00E+00*	*0.00E+00*	0.00E+00	*0.00E+00*	*0.00*	1.00E-02	7.00E-03
93	Copper	s	7440-50-8	M	63.55	0.00E+00	--------	1.60	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	-0.57	2.90E-01	2.50E-01
94	Copper cyanide	s	544-92-3	I	115.58	CE	--------	1.54	CE	CE	0.00E+00	0.00E+00	-1.49	2.90E-01	2.50E-01
95	Cresol, m-	l	108-39-4	O	108.14	3.62E-05	1.94	-----	7.40E-02	1.00E-05	2.30E+04	1.40E-01	2.06		
96	Cresol, o-	s	95-48-7	O	108.14	6.65E-05	1.99	------	7.40E-02	8.30E-06	2.04E+04	3.20E-01	2.06		
97	Cresol, p-	s	106-44-5	O	108.14	3.99E-05	1.91	------	7.40E-02	1.00E-05	2.30E+04	1.30E-01	2.06		
98	Crotonaldehyde	l	123-73-9	O	70.09	8.15E-04	*0.21*	------	9.37E-02	1.02E-05	1.60E+05	1.90E+01	0.60		
99	Cumene	l	98-82-8	O	120.19	6.07E-01	3.54	------	6.50E-02	7.10E-06	5.00E+01	4.60E+00	3.45		
100	Cyanide	CE	57-12-5	I	26.02	CE	--------	1.00	5.21E-01	2.28E-05	1.00E+05	1.38E+01	-0.69		
101	Cyanogen	g	460-19-5	O	52.04	2.06E-01	*0.13*	------	2.04E-01	1.37E-05	1.00E+04	3.88E+03	0.07		
102	Cyanogen bromide	s	506-68-3	O	105.92	4.41E+02	*-0.49*	------	6.24E-02	1.13E-05	1.31E+00	1.00E+02	-0.29		
103	Cyclohexanone	l	108-94-1	O	98.14	4.99E-04	*0.74*	-----	7.72E-02	8.73E-06	2.30E+04	4.00E+00	1.13		
104	Cyclotrimethylenetrinitramine	s	121-82-4	O	222.12	4.99E-04	1.80	-----	*6.65E-02*	*6.39E-06*	3.87E+01	1.00E-09	0.87		
105	DDD	s	72-54-8	O	320.05	1.66E-04	4.93	------	1.69E-02	4.76E-06	9.00E-02	8.66E-07	5.87		
106	DDE	s	72-55-9	O	241.93	8.73E-04	5.04	-----	1.44E-02	5.87E-06	6.50E-02	5.66E-06	6.00		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
107	DDT	s	50-29-3	O	354.49	2.23E-03	5.14	-----	1.37E-02	4.95E-06	3.10E-03	3.93E-07	6.79		
108	Di-n-butyl phthalate	l	84-74-2	O	278.35	5.94E-05	4.53	-----	4.38E-02	7.86E-06	1.12E+01	4.25E-05	4.61		
109	Di-n-octyl phthalate	l	117-84-0	O	390.56	2.78E-03	7.92	-----	1.51E-02	3.90E-06	2.00E-02	4.47E-06	8.54		
110	Diallate	s	2303-16-4	O	270.22	1.58E-04	3.28	-----	8.00E-02	8.00E-06	1.40E+01	1.50E-04	4.08		
111	Diazinon	l	333-41-5	O	304.35	4.70E-06	2.12	-----	1.80E-02	4.90E-06	4.00E+01	8.40E-05	3.86		
112	Dibenz-a,h-anthracene	s	53-70-3	O	278.35	4.66E-07	6.28	-----	2.00E-02	5.18E-06	5.00E-04	2.10E-11	6.70		
113	Dibromo-3-chloropropane, 1,2-	l	96-12-8	O	236.33	8.31E-03	2.23	-----	8.00E-02	8.00E-06	1.00E+03	7.60E-01	2.68		
114	Dibromochloromethane	l	124-48-1	O	208.28	3.25E-02	1.80	-----	1.96E-02	1.05E-05	5.25E+03	1.50E+01	1.70		
115	Dicamba	s	1918-00-9	O	209.03	3.28E-07	0.34	-----	*6.02E-02*	*6.69E-06*	5.60E+03	9.70E-05	2.14		
116	Dichlorobenzene, 1,2-	l	95-50-1	O	147.00	8.73E-02	2.84	-----	6.90E-02	7.90E-06	1.50E+02	1.36E+00	3.28		
117	Dichlorobenzene, 1,3-	l	541-73-1	O	147.00	1.95E-01	2.23	----	6.80E-02	8.13E-06	1.10E+02	2.30E+00	3.28		
118	Dichlorobenzene, 1,4-	s	106-46-7	O	147.00	1.17E-01	2.81	-----	6.90E-02	7.90E-06	7.38E+01	1.06E+00	3.28		
119	Dichlorobenzidine, 3,3-	s	91-94-1	O	253.13	8.65E-07	2.86	-----	1.94E-02	6.74E-06	3.11E+00	2.20E-07	3.21		
120	Dichloro-2-butene, 1,4	l	764-41-0	O	125.00	1.24E-02	2.26	------	7.43E-02	8.62E-06	6.91E+03	1.26E+01	2.60		
121	Dichlorodifluoromethane	l	75-71-8	O	120.91	1.67E+01	2.11	----	5.20E-02	1.05E-05	2.80E+02	4.80E+03	1.82		
122	Dichloroethane, 1,1-	l	75-34-3	O	98.96	2.39E-01	1.50	-----	7.42E-02	1.05E-05	5.50E+03	2.28E+02	1.76		
123	Dichloroethane, 1,2-	l	107-06-2	O	98.96	5.32E-02	1.24	------	1.04E-01	9.90E-06	8.70E+03	8.13E+01	1.83		
124	Dichloroethylene, 1,1-	l	75-35-4	O	96.94	1.06E+00	1.81	------	9.00E-02	1.04E-05	2.40E+03	5.91E+02	2.12		
125	Dichloroethylene, cis-1,2-	l	156-59-2	O	96.94	1.87E-01	1.46	------	7.35E-02	1.13E-05	4.93E+03	1.75E+02	1.86		
126	Dichloroethylene, trans-1,2	l	156-60-5	O	96.94	3.90E-01	1.70	------	7.07E-02	1.19E-05	6.30E+03	3.52E+02	2.07		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
127	Dichlorophenol, 2,4-	s	120-83-2	OA	163.00	1.31E-04	1.86	------	3.46E-02	8.77E-06	4.50E+03	7.15E-02	2.80		
128	Dichlorophenoxyacetic acid, 2,4-	s	94-75-7	O	221.04	5.82E-09	2.95	------	5.90E-02	6.50E-06	8.90E+02	2.40E-05	2.62		
129	Dichloropropane, 1,2	l	78-87-5	O	112.99	1.17E-01	1.77	------	7.82E-02	8.73E-06	2.80E+03	5.00E+01	2.25		
130	Dichloro-1-propanol, 2,3-	l	616-23-9	O	128.99	3.97E-05	1.53	------	4.84E-02	9.84E-06	2.95E+05	*5.82E-01*	0.78		
131	Dichloropropene, 1,3-	l	542-75-6	O	110.97	1.23E-01	1.72	------	6.26E-02	1.00E-05	1.55E+03	3.12E+01	1.75		
132	Dichloropropene, 1,3-cis	l	10061-01-5	O	110.97	9.15E-02	1.65	------	*7.94E-02*	8.00E-06	2.70E+03	3.70E+01	1.53		
133	Dichloropropene, 1,3-trans	l	10061-02-6	O	110.97	9.15E-02	1.65	------	*7.94E-02*	9.20E-06	2.80E+03	3.00E+01	1.53		
134	Dichlorvos	l	62-73-7	O	220.98	3.98E-05	9.59	------	2.32E-02	7.80E-06	1.60E+04	5.27E-02	1.40		
135	Dieldrin	s	60-57-1	O	380.91	1.11E-04	4.33	------	1.25E-02	4.74E-06	1.95E-01	9.96E-07	5.45		
136	Diethylhexyl adipate	l	103-23-1	O	370.57	*9.78E-01*	5.58	------	*3.56E-02*	3.72E-06	1.71E-03	8.25E-05	8.12		
137	Diethyl phthalate	l	84-66-2	O	222.24	1.87E-05	2.18	------	2.56E-02	6.35E-06	1.08E+03	1.65E-03	2.65		
138	Diethylstilbestrol	s	56-53-1	O	268.36	2.62E-13	4.88	------	*4.43E-02*	8.00E-06	1.30E+04	1.06E-09	5.64		
139	Dimethoate	s	60-51-5	O	229.26	2.58E-09	0.63	------	8.00E-02	8.00E-06	2.50E+04	5.09E-06	0.28		
140	Dimethoxybenzidine, 3,3'-	s	119-90-4	O	244.29	1.66E-08	1.78	------	2.42E-02	5.50E-06	2.40E+02	2.50E-07	2.08		
141	Dimethylbenzidine, 3,3'-	s	119-93-7	O	212.29	5.40E-09	2.30	-----	*5.10E-02*	8.00E-06	2.40E+02	3.70E-07	3.02		
142	Dimethylhydrazine, 1,1-	l	57-14-7	O	60.10	4.16E-06	-0.70	-----	1.06E-01	1.04E-05	1.24E+08	1.57E+02	-1.19		
143	Dimethylhydrazine, 1,2-	l	540-73-8	O	60.10	1.72E-04	0.59	------	*1.04E-01*	1.10E-05	1.18E+07	*6.63E+01*	-0.54		
144	Dimethyl phenol, 2,4-	s	105-67-9	O	122.17	8.31E-05	2.07	------	5.84E-02	8.69E-06	6.20E+03	1.26E-01	2.61		
145	Dimethyl phthalate	l	131-11-3	O	194.19	2.40E-05	1.50	------	5.68E-02	6.30E-06	4.19E+03	9.12E-03	1.66		
146	Dinitrobenzene, 1,3-	s	99-65-0	O	168.11	4.57E-06	1.48	------	2.80E-01	7.60E-06	5.40E+02	2.49E-04	1.63		
147	Dinitrobenzene, 1,4-	s	100-25-4	O	168.11	*4.44E-06*	*1.42*	------	6.15E-02	7.18E-06	1.00E+02	*4.83E-05*	1.63		
148	Dinitrophenol, 2,4-	s	51-28-5	OA	184.11	2.01E-07	-2.00	------	2.73E-02	9.06E-06	5.80E+03	1.14E-04	1.73		
149	Dinitrotoluene, 2,4-	s	121-14-2	O	182.14	3.60E-05	1.71	------	2.03E-01	7.06E-06	2.85E+02	1.74E-04	2.18		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	LogK_{oc}	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
150	Dinitrotoluene, 2,6-	s	606-20-2	O	182.14	3.11E-05	1.62	------	3.27E-02	7.26E-06	1.82E+02	5.70E-04	2.18		
151	Dinoseb	s	88-85-7	O	240.22	2.08E-02	3.08	------	2.25E-02	6.25E-06	5.20E+01	7.52E-02	3.67		
152	Dioxane, 1,4-	l	123-91-1	O	88.11	2.04E-04	-0.27	-----	2.30E-01	1.00E-05	9.00E+05	3.80E+01	-0.32		
153	TCDDioxins, 2,3,7,8-	s	1746-01-6	O	321.97	1.47E-03	7.15	-----	4.70E-02	8.00E-06	1.93E-05	7.40E-10	7.02		
154	TCDDioxins, 1,2,3,7-	s	67028-18-6	O	321.97	3.16E-04	5.98	-----	*4.80E-02*	*5.28E-06*	4.20E-05	5.25E-08	6.91		
155	TCDDioxins, 1,3,6,8-	s	33423-92-6	O	321.97	2.91E-04	4.36	-----	*4.80E-02*	*5.28E-06*	3.20E-04	5.25E-09	7.20		
156	TCDDioxins, 1,2,3,4-	s	30746-58-8	O	321.97	1.55E-03	CE	-----	*4.80E-02*	*5.28E-06*	4.70E-04	4.73E-08	7.18		
157	PeCDDioxins, 1,2,3,7,8-	s	40321-76-4	O	356.42	1.08E-04	5.70	-----	*4.64E-02*	*5.07E-06*	1.20E-04	9.48E-10	7.56		
158	PeCDDioxins, 1,2,3,4,7-	s	39227-61-7	O	356.42	1.08E-04	5.80	-----	*4.64E-02*	*5.07E-06*	1.20E-04	7.50E-10	7.56		
159	HxCDDioxins, 1,2,3,4,7,8-	s	39227-28-6	O	390.86	1.85E-03	6.02	-----	*4.49E-02*	*4.87E-06*	4.42E-06	8.80E-11	8.21		
160	HpCDDioxins, 1,2,3,4,6,7,8-	s	35822-46-9	O	425.31	3.12E-04	7.00	-----	*4.35E-02*	*4.70E-06*	2.40E-06	3.21E-11	8.85		
161	OCDDioxins	s	3268-87-9	O	459.75	2.80E-04	7.08	-----	4.30E-02	*4.54E-06*	4.00E-07	8.25E-13	9.50		
162	Diphenylamine	s	122-39-4	O	169.23	1.83E-04	2.54	-----	6.80E-02	6.30E-06	3.00E+02	4.26E-03	3.29		
163	Diphenylhydrazine, 1,2-	s	122-66-7	O	184.24	1.42E-07	2.82	-----	*5.62E-02*	5.70E-06	1.84E+03	2.60E-05	3.06		
164	Diquat dibromide	s	85-00-7	O	344.05	2.69E-12	2.31	-----	*5.52E-02*	*5.52E-06*	7.00E+05	1.00E-07	-2.82		
165	Disulfoton	s	298-04-4	O	274.41	2.58E-04	3.95	-----	8.00E-02	8.00E-06	1.60E+01	2.30E-04	3.86		
166	Diuron	s	330-54-1	O	233.10	*3.04E-08*	2.63	-----	*5.40E-02*	5.30E-06	4.20E+01	*1.00E-07*	2.67		
167	Endosulfan	s	115-29-7	O	406.93	4.66E-04	2.87	------	1.15E-02	4.55E-06	5.10E-01	9.96E-06	3.84		
168	Endothall	s	145-73-3	O	230.13	1.08E-08	1.93	------	CE	CE	1.00E+05	1.80E-04	1.89		
169	Endrin	s	72-20-8	O	380.91	4.95E-05	3.97	------	1.25E-02	4.74E-06	2.50E-01	5.84E-07	5.45		
170	Epichlorohydrin	l	106-89-8	O	92.53	1.37E-03	0.30	------	8.60E-02	9.80E-06	6.60E+04	1.67E+01	0.63		
171	Ethion	l	563-12-2	O	384.48	2.87E-05	4.19	------	CE	CE	1.20E+00	1.50E-06	4.75		
172	Ethoxy ethanol, 2-	l	110-80-5	O	90.12	1.04E-05	2.10E-01	------	7.77E-02	8.30E-06	5.29E+05	1.12E+00	1.66E-01		
173	Ethoxyethanol acetate, 2-	l	111-15-9	O	132.16	3.77E-05	*0.20*	------	6.10E-02	7.29E-06	2.30E+05	2.00E+00	0.59		
174	Ethyl acetate	l	141-78-6	O	88.11	5.57E-03	0.72	------	7.30E-02	9.70E-06	7.90E+04	9.41E+01	0.86		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
175	Ethyl acrylate	l	140-88-5	O	100.12	1.06E-02	2.03	------	7.40E-02	8.68E-06	2.00E+04	2.95E+01	1.22		
176	Ethyl benzene	l	100-41-4	O	106.17	3.28E-01	2.31	------	7.50E-02	7.80E-06	1.69E+02	9.60E+00	3.03		
177	S-Ethyl dipropylthiocarbamate	l	759-94-4	O	189.32	4.57E-03	2.38	------	*5.35E-02*	*5.65E-06*	3.70E+02	1.60E-01	3.02		
178	Ethyl ether	l	60-29-7	O	74.12	2.70E-02	0.88	-----	7.40E-02	9.30E-06	6.10E+04	5.40E+02	1.05		
179	Ethyl methacrylate	l	97-63-2	O	114.14	6.65E-03	1.57	------	8.00E-02	8.00E-06	1.90E+04	1.75E+01	1.77		
180	Ethyl-2-methylbenzene, 1-	l	611-14-3	O	120.19	2.19E-01	*3.03*	____	6.76E-02	7.29E-06	7.46E+01	2.48E+00	3.53		
181	Ethyl-4-methylbenzene, 1-	l	622-96-8	O	120.19	3.27E-01	*3.07*	____	6.70E-02	7.18E-06	9.49E+01	2.95E+00	3.58		
182	Ethylenediamine	l	107-15-3	O	60.10	7.19E-08	0.67	------	1.53E-01	1.12E-05	7.95E+06	1.10E+01	-1.62		
183	Ethylene dibromide	l	106-93-4	O	187.86	2.93E-02	1.73	------	2.17E-02	1.90E-05	4.32E+03	1.10E+01	2.01		
184	Ethylene glycol	l	107-21-1	O	62.07	2.49E-06	-0.90	-----	1.08E-01	1.22E-05	1.00E+06	7.00E-02	-1.20		
185	Ethylene oxide	g	75-21-8	O	44.05	4.92E-03	0.34	------	1.04E-01	1.45E-05	3.83E+05	1.32E+03	-0.05		
186	Ethylene thiourea	s	96-45-7	O	102.16	4.99E-05	-0.66	------	7.15E-02	1.02E-05	1.20E+04	8.36E-02	-0.49		
187	Fluoranthene	s	206-44-0	O	202.26	3.88E-04	4.69	------	3.02E-02	6.35E-06	2.60E-01	8.13E-06	4.93		
188	Fluorene	s	86-73-7	O	166.22	2.64E-03	3.88	------	3.63E-02	7.88E-06	1.98E+00	3.24E-03	4.02		
189	Fluorine (soluble Fluoride)	g	7782-41-4	I	38.00	CE	--------	2.18	CE	CE	NA/reacts	7.60E+02	0.22		
190	Formaldehyde	g	50-00-0	O	30.03	1.37E-05	0.34	------	1.80E-01	2.00E-05	5.50E+05	3.88E+03	0.35		
191	Formic acid	l	64-18-6	O	46.03	1.79E-04	-0.54	------	7.90E-02	1.40E-06	1.00E+06	4.10E+01	-0.46		
192	TCDFurans, 2,3,7,8-	s	51207-31-9	O	305.98	6.16E-04	5.20	------	*4.86E-02*	*5.41E-06*	4.19E-04	1.50E-08	6.29		
193	PeCDFuran, 1,2,3,7,8-	s	57117-41-6	O	340.42	*2.11E-04*	*6.73*	-----	*4.69E-02*	*5.18E-06*	2.40E-04	2.72E-09	6.94		
194	PeCDFuran, 2,3,4,7,8-	s	57117-31-4	O	340.42	*2.44E-04*	7.40	------	*4.69E-02*	*5.18E-06*	2.36E-04	2.63E-09	6.94		
195	HxCDFurans, 1,2,3,4,7,8-	s	70648-26-9	O	374.87	5.97E-04	7.40	------	4.50E-02	*4.97E-06*	8.25E-06	2.40E-10	7.92		
196	HxCDFurans, 1,2,3,6,7,8-	s	57117-44-9	O	374.87	2.54E-04	7.55	-----	4.50E-02	*4.97E-06*	1.77E-05	2.20E-10	7.92		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	LogK_{oc}	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
197	HxCDFurans, 2,3,4,6,7,8-	s	60851-34-5	O	374.87	1.70E-03	7.54	-----	4.50E-02	*4.97E-06*	1.30E-05	2.00E-10	7.92		
198	HpCDFurans, 1,2,3,4,6,7,8-	s	67562-39-4	O	409.31	1.54E-03	6.37	-----	4.30E-02	*4.79E-06*	1.35E-06	3.82E-10	8.23		
199	HpCDFurans, 1,2,3,4,7,8,9-	s	55673-89-7	O	409.31	1.58E-03	5.00	------	4.30E-02	*4.79E-06*	1.40E-06	1.07E-10	6.90		
200	OCDFurans	s	39001-02-0	O	443.76	7.90E-05	6.75	-----	*4.27E-02*	*4.62E-06*	1.20E-06	3.75E-12	8.87		
201	Furan	l	110-00-9	O	68.08	2.24E-01	1.32	------	1.04E-01	1.20E-05	1.00E+04	6.00E+02	1.36		
202	Fufural	l	98-01-1	O	96.09	1.25E-04	*0.44*	------	8.72E-02	1.12E-05	8.60E+04	2.00E+00	0.83		
203	Glycidylaldehyde	l	765-34-4	O	72.06	1.08E-05	0.96	------	*9.64E-02*	*1.16E-05*	8.55E+07	2.70E+01	-0.12		
204	Heptachlor	s	76-44-8	O	373.32	2.44E-02	4.07	------	1.12E-02	5.69E-06	1.80E-01	3.26E-04	6.21		
205	Heptachlor epoxide	s	1024-57-3	O	389.32	3.45E-04	3.86	------	1.32E-02	4.23E-06	2.75E-01	4.34E-06	4.91		
206	Hexachlorobenzene	s	118-74-1	O	284.78	2.22E-02	4.45	------	5.42E-02	5.91E-06	6.00E-03	1.23E-05	5.86		
207	Hexachloro-1,3-butadiene	l	87-68-3	O	260.76	9.94E-01	3.84	------	5.61E-02	6.16E-06	2.55E+00	1.77E-01	4.72		
208	Hexachlorocyclohexane, techn	CE	608-73-1	O	290.83	5.99E-05	3.38	------	*1.42E-02*	*7.34E-06*	4.35E+01	1.64E-04	4.26		
209	Hexachlorocyclohexane, alpha	s	319-84-6	O	290.83	2.82E-04	3.12	------	1.42E-02	7.34E-06	2.00E+00	4.26E-05	4.26		
210	Hexachlorocyclohexane, beta	s	319-85-7	O	290.83	1.44E-05	3.14	------	1.42E-02	7.34E-06	5.42E-01	4.90E-07	4.26		
211	Hexachlorocyclohexane, gamma	s	58-89-9	O	290.83	1.41E-04	3.04	------	1.42E-02	7.34E-06	5.75E+00	3.72E-05	4.26		
212	Hexachlorocyclopentadiene	l	77-47-4	O	273.78	7.15E-01	3.98	-----	1.61E-02	7.21E-06	1.80E+00	7.32E-02	4.63		
213	Hexachloroethane	s	67-72-1	O	236.74	1.62E-01	3.26	------	2.50E-03	6.80E-06	5.00E+01	4.72E-01	4.03		
214	Hexachlorophene	s	70-30-4	O	406.91	2.54E-09	7.30	------	8.00E-02	8.00E-06	3.00E-03	2.74E-12	6.92		
215	Hexane, n-	l	110-54-3	O	86.18	4.66E+01	2.68	------	2.00E-01	7.77E-06	1.30E+01	1.52E+02	3.29		
216	Hexazinone	s	51235-04-2	O	252.32	8.62E-11	1.57	------	*5.08E-02*	*5.11E-06*	3.30E+04	2.03E-07	2.15		
217	Hydrazine	l	302-01-2	O	32.05	7.20E-08	-1.00	------	4.16E-01	1.90E-05	3.41E+08	1.40E+01	-1.47		
218	Hydrogen chloride	g	7647-01-0	I	36.46	9.30E-02	--------	CE	*1.67E-01*	*2.05E-05*	6.60E+05	3.08E+04	0.54		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
219	Hydrogen cyanide	g	74-90-8	I	27.03	5.40E-03	--------	CE	*1.73E-01*	*1.96E-05*	1.00E+06	6.20E+02	-0.69		
220	Hydrogen sulfide	g	7783-06-4	I	34.08	9.56E-01	--------	CE	1.76E-01	1.61E-05	4.13E+03	1.52E+04	0.23		
221	Indene	l	95-13-6	O	116.16	2.08E-02	2.50	------	6.82E-02	7.97E-06	3.90E+02	1.30E+00	2.80		
222	Indeno-(1,2,3-cd)-pyrene	s	193-39-5	O	276.34	2.85E-06	6.54	------	1.90E-02	5.66E-06	3.75E-03	1.40E-10	6.70		
223	Isobutyl alcohol	l	78-83-1	O	74.12	4.99E-04	0.75	------	8.60E-02	8.00E-06	9.49E+04	1.00E+01	0.77		
224	Isophorone	l	78-59-1	O	138.21	2.57E-04	1.48	------	6.23E-02	6.76E-06	1.20E+04	4.10E-01	2.62		
225	Kepone	s	143-50-0	O	490.64	1.04E-06	4.43	------	*4.22E-02*	*4.30E-06*	7.60E+00	2.25E-07	4.91		
226	Lead	s	7439-92-1	M	207.20	0.00E+00	--------	1.00	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	0.73		
227	Malathion	l	121-75-5	O	330.36	9.98E-07	2.46	------	1.50E-02	4.40E-06	1.45E+02	7.90E-06	2.29		
228	Maleic anhydride	s	108-31-6	O	98.06	8.31E-06	*1.41*	------	9.50E-02	1.11E-05	*8.65E+02*	1.34E-03	1.62		
229	Maleic hydrazide	s	123-33-1	O	112.09	< 1.03E-10	1.40	------	*8.75E-02*	*8.75E-06*	6.00E+03	< 7.50E-08	-0.89		
230	Malononitrile	s	109-77-3	O	66.06	1.97E-07	0.69	------	*9.97E-02*	*1.09E-05*	6.96E+06	3.79E-01	-0.18		
231	Manganese	s	7439-96-5	M	54.94	0.00E+00	--------	1.70	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	1.00E-01	5.00E-02
232	Mercury	l	7439-97-6	M	200.59	4.74E-01	--------	-1.40	3.07E-02	6.30E-06	3.00E-02	1.30E-03	-0.47	5.50E-03	1.40E-02
233	Methacrylonitrile	l	126-98-7	O	67.09	3.03E-03	0.53	------	8.00E-02	8.00E-06	2.50E+04	6.80E+01	0.76		
234	Methanol	l	67-56-1	O	32.04	1.94E-04	-0.74	------	1.50E-01	1.64E-05	1.00E+06	1.22E+02	-0.63		
235	Methomyl	s	16752-77-5	O	162.21	7.48E-09	2.20	------	4.07E-02	7.20E-06	5.80E+04	5.00E-05	0.61		
236	Methoxychlor	s	72-43-5	O	345.65	6.57E-04	4.89	-----	1.56E-02	4.46E-06	4.50E-02	1.23E-06	5.67		
237	Methoxyethanol	l	109-86-4	O	76.10	1.28E+00	0.93	------	*9.15E-02*	1.02E-05	*2.01E+01*	6.20E+00	-0.91		
238	Methoxyethanol acetate	l	110-49-6	O	118.13	1.28E+00	1.40	------	*7.22E-02*	8.10E-06	*3.52E+01*	7.00E+00	0.10		
239	Methyl ethyl ketone	l	78-93-3	O	72.11	1.94E-03	0.28	------	8.08E-02	9.80E-06	2.40E+05	9.10E+01	0.26		
240	Methyl isobutyl ketone	l	108-10-1	O	100.16	5.82E-03	1.18	------	7.50E-02	7.80E-06	1.90E+04	1.45E+01	1.16		
241	Methyl mercury	CE	22967-92-6	I	215.62	CE	--------	CE	CE	CE	CE	CE	0.08		
242	Methyl methacrylate	l	80-62-6	O	100.12	1.33E-02	1.36	------	7.70E-02	8.60E-06	1.60E+04	3.80E+01	1.28		
243	Methyl naphthalene, 1-	s	90-12-0	O	142.20	1.64E-02	3.36	------	6.31E-02	7.13E-06	2.80E+01	6.62E-02	3.72		
244	Methyl naphthalene, 2-	s	91-57-6	O	142.20	1.85E-02	3.64	------	6.29E-02	7.20E-06	2.54E+01	6.75E-02	3.72		
245	Methyl parathion	s	298-00-0	O	263.21	5.82E-06	2.81	------	8.00E-02	8.00E-06	5.00E+01	1.52E-05	2.75		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
246	Methylene-bis (2-chloroaniline), 4,4'-	s	101-14-4	O	267.16	1.40E-05	3.90	------	1.99E-02	5.80E-06	7.24E+01	6.94E-05	3.47		
247	Methylene bromide	l	74-95-3	O	173.83	3.49E-02	2.26	------	8.00E-02	8.00E-06	1.10E+04	4.56E+01	1.52		
248	Methylene chloride	l	75-09-2	O	84.93	9.10E-02	1.07	------	1.01E-01	1.17E-05	1.54E+04	4.55E+02	1.34		
249	Molinate	l	2212-67-1	O	187.31	5.25E-05	1.70	------	*5.65E-02*	*6.00E-06*	9.00E+02	5.60E-03	2.91		
250	Molybdenum	s	7439-98-7	M	95.94	0.00E+00	--------	1.30	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	1.00E-01	6.00E-02
251	MTBE	l	1634-04-4	O	88.15	2.44E-02	1.15	------	*7.92E-02*	*9.41E-05*	4.80E+04	2.49E+02	1.43		
252	Naled	l	300-76-5	O	380.78	2.71E-03	2.12	------	CE	6.80E-06	1.50E+00	2.00E-04	1.60		
253	Naphthalene	s	91-20-3	O	128.17	2.00E-02	3.19	------	5.90E-02	7.50E-06	3.14E+01	8.89E-02	3.17		
254	Nickel and compounds (soluble salts)	s	7440-02-0	M	58.69	0.00E+00	--------	1.20	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	-0.57	2.50E-02	8.00E-03
255	Nickel, refinery dust	CE	No CAS NUM	I	CE	CE	--------	CE	CE	CE	CE	CE	CE	2.50E-02	8.00E-03
256	Nitrate	CE	14797-55-8	I	62.00	CE	--------	CE	CE	CE	CE	CE	0.21		
257	Nitrite	CE	14797-65-0	I	46.01	CE	--------	CE	CE	CE	CE	CE	0.06		
258	Nitroaniline 2-	s	88-74-4	O	138.13	2.08E-05	1.43	------	5.99E-02	7.18E-06	1.26E+03	4.75E-03	2.02		
259	Nitrobenzene	l	98-95-3	O	123.11	8.56E-04	2.12	------	7.60E-02	8.60E-06	1.90E+03	2.44E-01	1.81		
260	Nitropropane, 2-	l	79-46-9	O	89.09	5.15E-03	0.54	------	9.23E-02	1.01E-05	1.70E+04	1.82E+01	0.87		
261	Nitroso-n-ethylurea, n-	s	759-73-9	O	117.11	1.05E-04	1.51	------	*8.08E-02*	*8.25E-06*	4.85E+04	7.97E-01	-0.02		
262	Nitroso-n-methylurea, n-	CE	684-93-5	O	103.08	1.08E-06	1.23	------	7.06E-02	1.02E-05	*4.21E+06*	8.04E-01	-0.52		
263	Nitroso-methyl-ethyl-amine, n-	CE	10595-95-6	O	88.11	3.70E-05	1.32	------	8.00E-02	8.00E-06	3.00E+05	2.28E+00	-0.15		
264	Nitrosodi-n-butylamine, n-	CE	924-16-3	O	158.24	3.58E-03	2.36	------	8.00E-02	8.00E-06	1.20E+03	2.89E-01	2.31		
265	Nitrosodi-n-propylamine, n-	s	621-64-7	O	130.19	9.35E-05	1.30	------	5.45E-02	8.17E-06	9.89E+03	4.00E-01	1.35		
266	Nitrosodiethanolamine	l	1116-54-7	O	134.14	2.05E-09	0.48	------	*7.27E-02*	*7.70E-06*	7.33E+07	5.00E-04	-1.28		
267	Nitrosodiethylamine, N-	l	55-18-5	O	102.14	3.60E-05	0.48	------	8.00E-02	8.00E-06	1.47E+05	1.42E+00	0.34		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
268	Nitrosodimethylamine, N-	l	62-75-9	O	74.08	2.16E-05	0.56	------	1.34E-01	9.72E-06	1.00E+06	5.37E+00	-0.64		
269	Nitrosodiphenylamine	s	86-30-6	O	198.22	2.08E-04	2.52	------	3.12E-02	6.35E-06	3.51E+01	9.88E-02	3.16		
270	Nitrosopyrrolidine, n-	l	930-55-2	O	100.12	7.48E-07	-0.19	------	8.00E-02	8.00E-06	7.80E+05	1.75E-01	0.23		
271	Nitrotoluene, m	l	99-08-1	O	137.14	2.24E-03	*2.15*	------	6.42E-02	7.69E-06	4.98E+02	1.50E-01	2.36		
272	Nitrotoluene, o	l	88-72-2	O	137.14	1.87E-03	*2.15*	------	6.47E-02	7.73E-06	6.00E+02	1.50E-01	2.36		
273	Nitrotoluene, p	s	99-99-0	O	137.14	2.29E-03	*2.15*	------	6.40E-02	7.70E-06	4.00E+02	1.20E-01	2.36		
274	Octamethylpryrophosphoramide	l	152-16-9	O	286.25	1.16E-08	-0.51	------	8.00E-02	8.00E-06	1.00E+06	9.88E-04	-1.01		
275	Oxamyl	s	23135-22-0	O	219.26	1.60E-11	0.70	------	*5.57E-02*	*5.75E-06*	2.80E+05	3.83E-07	-1.20		
276	Parathion	s	56-38-2	O	291.26	2.37E-05	3.75	------	1.70E-02	5.80E-06	1.18E+01	1.73E-05	3.73		
277	Pebulate	l	1114-71-2	O	203.35	9.85E-04	2.63	------	*5.10E-02*	*5.38E-06*	9.20E+01	8.85E-03	3.51		
278	Pentachlorobenzene	s	608-93-5	O	250.34	3.16E-02	4.50	------	6.70E-02	6.30E-06	6.50E-01	1.67E-03	5.22		
279	Pentachloronitrobenzene	s	82-68-8	O	295.34	2.57E-02	4.11	------	1.59E-02	6.10E-06	7.11E-02	1.13E-04	5.03		
280	Pentachlorophenol	s	87-86-5	OA	266.34	1.16E-05	2.61	------	5.60E-02	6.10E-06	1.40E+01	1.70E-05	4.74		
281	Phenanthrene	s	85-01-8	O	178.23	5.40E-03	4.15	------	3.33E-02	7.47E-06	9.94E-01	6.80E-04	4.35		
282	Phenol	s	108-95-2	O	94.11	2.47E-05	1.24	------	8.20E-02	9.10E-06	8.70E+04	4.63E-01	1.51		
283	Phenyl mercuric acetate	s	62-38-4	O	336.74	3.41E-09	2.20	------	8.00E-02	8.00E-06	4.37E+03	3.04E-06	0.89		
284	Phenylene diamine, m-	s	108-45-2	O	108.14	9.56E-07	0.04	------	6.63E-02	9.90E-06	3.51E+05	2.28E-02	-0.39		
285	Phenylene diamine, p-	s	106-50-3	O	108.14	5.24E-08	*0.04*	------	7.15E-02	8.92E-06	3.80E+04	4.60E-03	-0.39		
286	Phorate	l	298-02-2	O	260.38	4.99E-04	3.74	------	8.00E-02	8.00E-06	4.40E+01	1.30E-03	3.37		
287	Phosphine	g	7803-51-2	I	34.00	*1.46E+02*	--------	CE	3.81E-01	1.82E-05	4.00E+02	3.14E+04	-0.27		
288	Phosphoric acid	s	7664-38-2	I	98.00	CE	--------	CE	CE	CE	CE	3.00E-02	-0.77		
289	Phosphorus, white	s	7723-14-0	I	123.90	*5.65E-02*	3.05	------	CE	CE	3.00E+00	2.50E-02	3.08		
290	Phthalic anhydride	s	85-44-9	O	148.12	2.54E-07	1.90	------	6.36E-02	7.90E-06	6.20E+03	2.00E-04	2.07		
291	Polybrominated biphenyls	s	67774-32-7	O	627.59	1.62E-04	3.33	------	CE	*4.63E-06*	1.10E-02	5.20E-08	6.39		
292	Polychlorinated biphenyls	l	1336-36-3	O	290.00	1.75E-02	5.72	------	1.04E-01	1.00E-05	5.55E-02	7.60E-05	6.30		

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293	Potassium cyanide	s	151-50-8	I	65.12	*0.00E+00*	--------	CE	CE	CE	7.20E+05	0.00E+00	-1.69		
294	Pronamide	s	23950-58-5	O	256.13	3.74E-04	2.30	------	8.00E-02	8.00E-06	1.50E+01	4.00E-04	3.57		
295	Propargite	l	2312-35-8	O	350.48	1.44E-06	3.75	------	*3.94E-02*	*4.20E-06*	5.00E-01	4.48E-08	3.73		
296	Propargyl alcohol	l	107-19-7	O	56.06	1.34E-05	0.73	------	*1.04E-01*	*1.24E-05*	5.57E+06	1.20E+01	-0.42		
297	Propham	s	122-42-9	O	179.22	5.30E-06	1.71	------	*5.71E-02*	*6.28E-06*	2.50E+02	1.35E-04	2.66		
298	Propylene oxide	l	75-56-9	O	58.08	3.47E-03	*0.10*	------	1.04E-01	*1.16E-05*	4.76E+05	5.32E+02	0.03		
299	Pyrene	s	129-00-0	O	202.26	4.57E-04	4.58	------	2.72E-02	7.24E-06	1.35E-01	4.25E-06	4.93		
300	Pyridine	l	110-86-1	O	79.10	2.91E-01	0.64	------	9.10E-02	7.60E-06	3.00E+02	2.00E+01	0.80		
301	Quinoline	l	91-22-5	O	129.16	1.15E-04	2.76	------	5.46E-02	8.31E-06	6.78E+03	9.60E-02	2.14		
302	Selenious acid	s	7783-00-8	I	128.97	*1.27E-05*	--------	CE	CE	CE	1.67E+06	3.00E+00	-3.18	1.50E-02	2.20E-02
303	Selenium	s	7782-49-2	M	78.96	0.00E+00	--------	0.34	CE	CE	0.00E+00	0.00E+00	0.24	1.50E-02	2.20E-02
304	Selenourea	CE	630-10-4	O	118.98	CE	CE	------	CE	CE	CE	CE	-2.63		
305	Silver	s	7440-22-4	M	107.87	0.00E+00	--------	-1.00	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	1.70E-01	1.00E-01
306	Sodium azide	s	26628-22-8	I	65.01	CE	--------	CE	CE	CE	4.20E+05	CE	0.86		
307	Sodium cyanide	s	143-33-9	I	49.01	*0.00E+00*	--------	CE	CE	CE	5.80E+05	0.00E+00	-1.69		
308	Sodium diethyldithiocarbamate	s	148-18-5	O	171.26	CE	CE	------	CE	CE	CE	CE	0.27		
309	Sodium fluoride	s	7681-49-4	I	41.99	*0.00E+00*	--------	CE	CE	CE	4.00E+04	0.00E+00	-0.77		
310	Strychnine	s	57-24-9	O	334.42	6.65E-12	1.90	------	8.00E-02	8.00E-06	1.43E+02	1.67E-10	1.85		
311	Styrene	l	100-42-5	O	104.15	1.14E-01	2.88	------	7.10E-02	8.00E-06	3.10E+02	6.24E+00	2.90		
312	Tetrachlorobenzene, 1,2,4,5-	s	95-94-3	O	215.89	4.99E-02	3.20	------	2.11E-02	8.80E-06	3.00E-01	5.40E-03	4.57		
313	Tetrachloroethane, 1,1,1,2-	s	630-20-6	O	167.85	9.98E-02	2.98	------	7.10E-02	7.90E-06	1.10E+03	1.22E+01	2.93		
314	Tetrachloroethane, 1,1,2,2-	l	79-34-5	O	167.85	1.55E-02	1.89	------	7.10E-02	7.90E-06	2.97E+03	5.17E+00	2.19		
315	Tetrachloroethylene	l	127-18-4	O	165.83	7.65E-01	2.19	------	7.20E-02	8.20E-06	2.00E+02	1.84E+01	2.97		
316	Tetrachlorophenol, 2,3,4,6-	s	58-90-2	OA	231.89	2.54E-04	2.02	------	2.17E-02	7.10E-06	1.00E+02	5.02E-03	4.09		
317	Tetraethyl dithiopyrophosphate	l	3689-24-5	O	322.32	1.75E-04	2.87	------	1.50E-02	5.50E-06	2.50E+01	1.70E-04	3.98		

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318	Tetraethyl lead	l	78-00-2	O	323.45	3.31E+00	3.69	------	1.32E-02	6.40E-06	8.00E-01	1.50E-01	4.88		
319	Thallium chloride	s	7791-12-0	I	239.84	*0.00E+00*	--------	CE	CE	CE	2.90E+03	0.00E+00	CE	1.00E-03	4.00E-04
320	Thallium nitrate	s	10102-45-1	I	266.39	7.19E-11	--------	CE	CE	CE	9.55E+04	*4.71E-07*	CE		
321	Thallium sulfate	s	7446-18-6	I	504.83	*0.00E+00*	--------	CE	CE	CE	4.87E+04	0.00E+00	CE		
322	Thiofanox	s	39196-18-4	O	218.32	3.90E-07	1.77	------	2.55E-02	6.62E-06	5.20E+03	3.10E-04	2.16		
323	Thiophanatemethyl	s	23564-05-8	O	342.40	< 3.82E-07	0.95	------	*4.55E-02*	*4.68E-06*	3.50E+00	< 7.50E-08	1.50		
324	Thiram	s	137-26-8	O	240.44	< 3.28E-06	2.83	------	2.25E-02	6.24E-06	3.00E+01	< 7.50E-06	1.70		
325	Tin	s	7440-31-5	M	118.71	0.00E+00	--------	CE	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	1.29	1.00E-02	6.00E-03
326	Toluene	l	108-88-3	O	92.14	2.76E-01	2.15	------	8.70E-02	8.60E-06	5.30E+02	2.82E+01	2.54		
327	Toluenediamine, 2,4-	s	95-80-7	O	122.17	7.48E-08	3.11	------	8.00E-02	8.00E-06	7.47E+03	8.36E-05	0.16		
328	Toluenediamine, 2,6-	s	823-40-5	O	122.17	5.15E-10	CE	------	6.87E-02	7.97E-06	4.80E+04	1.98E-05	0.16		
329	Toluene diisocyanate, 2,4/2,6-	l	26471-62-5	O	174.16	6.86E-06	*3.35*	------	*6.09E-02*	*6.80E-06*	1.11E+05	8.00E-02	3.74		
330	Toluidine, p-	s	106-49-0	O	107.16	3.82E-04	1.40	------	8.00E-02	8.00E-06	7.20E+03	3.30E-01	1.62		
331	Toxaphene	s	8001-35-2	O	413.81	1.40E-04	4.98	------	1.16E-02	4.34E-06	7.40E-01	4.19E-06	6.79		
332	TP Silvex, 2,4,5-	s	93-72-1	O	269.51	5.45E-07	3.41	------	1.94E-02	5.80E-06	1.40E+02	5.20E-06	3.68		
333	Triallate	s	2303-17-5	O	304.67	4.53E-04	3.16	------	*4.58E-02*	*4.84E-06*	4.00E+00	1.20E-04	4.57		
334	Trichloro-1,2,2-trifluoroethane, 1,1,2	l	76-13-1	O	187.38	2.20E+01	3.11	------	7.80E-02	8.20E-06	2.00E+02	3.60E+02	3.09		
335	Trichlorobenzene, 1,2,4-	l	120-82-1	O	181.45	5.90E-02	3.22	------	3.00E-02	8.23E-06	4.88E+01	3.36E-01	3.93		
336	Trichloroethane, 1,1,1-	l	71-55-6	O	133.40	7.15E-01	2.04	------	7.80E-02	8.80E-06	1.33E+03	1.24E+02	2.68		
337	Trichloroethane, 1,1,2-	l	79-00-5	O	133.40	3.80E-02	1.70	------	7.92E-02	8.80E-06	4.42E+03	2.52E+01	2.01		
338	Trichloroethylene	l	79-01-6	O	131.39	4.28E-01	1.97	------	7.90E-02	9.10E-06	1.10E+03	7.20E+01	2.47		
339	Trichlorofluoromethane	l	75-69-4	O	137.37	4.03E+00	2.13	------	8.70E-02	9.70E-06	1.10E+03	6.87E+02	2.13		
340	Trichlorophenol, 2,4,5-	s	95-95-4	OA	197.45	1.78E-04	2.47	------	2.91E-02	7.03E-06	1.20E+03	1.63E-02	3.45		

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341	Trichlorophenol, 2,4,6-	s	88-06-2	OA	197.45	3.19E-04	2.12	------	3.18E-02	6.25E-06	9.82E+02	1.18E-02	3.45		
342	Trichlorophenoxyacetic acid, 2,4,5-	s	93-76-5	O	255.48	3.62E-07	1.72	------	8.00E-02	8.00E-06	2.78E+02	3.61E-06	3.26		
343	Trichloropropane, 1,1,2-	l	598-77-6	O	147.43	1.21E+00	2.24	------	3.96E-02	9.30E-06	4.44E+01	6.64E+00	2.43		
344	Trichloropropane, 1,2,3-	l	96-18-4	O	147.43	1.58E-02	2.59	------	7.10E-02	7.90E-06	1.90E+03	3.70E+00	2.50		
345	Triethylamine	l	121-44-8	O	101.19	1.99E-02	*1.12*	------	7.54E-02	7.51E-06	1.50E+04	5.00E+01	1.51		
346	Trifluralin	s	1582-09-8	O	335.28	2.01E-03	4.14	------	1.49E-02	4.70E-06	6.00E-01	1.10E-04	5.31		
347	Trimethylbenzene, 1,2,3-	l	526-73-8	O	120.19	1.33E-01	2.77	------	6.77E-02	7.41E-06	7.52E+01	1.49E+00	3.55		
348	Trinitrobenzene, 1,3,5-	s	99-35-4	O	213.11	2.87E-06	1.15	------	8.00E-02	8.00E-06	3.53E+02	9.90E-05	1.45		
349	Trinitrophenylmethylnitramine, 2,4,6-	s	479-45-8	O	287.15	8.31E-11	2.37	------	*5.69E-02*	6.40E-06	7.50E+01	4.00E-10	2.04		
350	Trinitrotoluene, 2,4,6-	s	118-96-7	O	227.13	1.90E-05	2.48	------	5.41E-02	6.57E-06	1.30E+02	1.24E-04	1.99		
351	Uranium	s	7440-61-1	M	238.03	*0.00E+00*	--------	3.47	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	5.00E-03	4.00E-03
352	Vanadium	s	7440-62-2	M	50.94	0.00E+00	--------	3.00	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	*0.00*	3.60E-03	3.00E-03
353	Vanadium pentoxide	s	1314-62-1	I	181.88	0.00E+00	--------	CE	CE	CE	8.00E+03	0.00E+00	CE	3.60E-03	3.00E-03
354	Vernam	l	1929-77-7	O	203.35	7.36E-04	3.44	------	*5.10E-02*	*5.39E-06*	9.85E+01	1.04E-02	3.51		
355	Vinyl acetate	l	108-05-4	O	86.09	2.29E-02	0.72	------	8.50E-02	9.20E-06	2.00E+04	1.09E+02	0.73		
356	Vinyl chloride	g	75-01-4	O	62.50	3.49E+00	1.04	------	1.06E-01	1.23E-05	2.76E+03	2.80E+03	1.62		
357	Warfarin	s	81-81-2	O	308.33	1.15E-07	2.96	------	1.63E-02	4.40E-06	1.70E+01	1.16E-07	3.20		
358	Xylenes	l	1330-20-7	O	106.17	2.93E-01	2.38	------	7.40E-02	8.50E-06	1.98E+02	8.06E+00	3.09		
359	Xylene, m-	l	108-38-3	O	106.17	3.05E-01	2.29	------	7.00E-02	7.80E-06	1.60E+02	8.00E+00	3.20		
360	Xylene, o-	l	95-47-6	O	106.17	7.36E-04	2.11	------	8.70E-02	1.00E-05	1.78E+02	6.75E+00	3.13		
361	Xylene, p-	l	106-42-3	O	106.17	3.18E-01	2.49	------	7.69E-02	8.44E-06	1.85E+02	8.76E+00	3.17		
362	Zinc	s	7440-66-6	M	65.39	0.00E+00	--------	1.20	*0.00E+00*	*0.00E+00*	0.00E+00	0.00E+00	-0.47	9.00E-02	4.40E-02
363	Zinc cyanide	s	557-21-1	I	117.43	CE	--------	1.60	CE	CE	0.00E+00	CE	-2.31		
364	Zinc phosphide	s	1314-84-7	I	258.12	0.00E+00	--------	1.60	CE	CE	0.00E+00	*0.00E+00*	CE		

	COMPOUND	Physical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)
365	6 C aliphatics (TPH)	l	---	O	81	3.3E+01	2.9	------	1.0E-01	1.0E-05	3.6E+01	2.7E+02	---		
366	>6-8 C aliphatics (TPH)	l	---	O	100	5.0E+01	3.6	------	1.0E-01	1.0E-05	5.4E+00	4.8E+01	---		
367	>8-10 C aliphatics (TPH)	l	---	O	130	8.0E+01	4.5	------	1.0E-01	1.0E-05	4.3E-01	4.8E+00	---		
368	>10-12 C aliphatics (TPH)	l	---	O	160	1.2E+02	5.4	------	1.0E-01	1.0E-05	3.4E-02	4.8E-01	---		
369	>12-16 C aliphatics (TPH)	l	---	O	200	5.2E+02	6.7	------	1.0E-01	1.0E-05	7.6E-04	3.6E-02	---		
370	>16-35 C aliphatics (TPH)	l	---	O	270	4.9E+03	8.8	------	1.0E-01	1.0E-05	2.5E-06	8.4E-04	---		
371	5-7 C aromatics (TPH) - Benzene	l		O	78	2.27E-01	1.82	------	8.8E-02	9.8E-06	1.77E+03	9.50E+01	---		
372	>7-8 C aromatics (TPH) - Toluene	l	---	O	92	2.76E-01	2.15	------	8.7E-02	8.6E-06	5.30E+02	2.82E+01	---		
370	>8-10 C aromatics (TPH)	l	---	O	120	4.8E-01	3.2	------	1.0E-01	1.0E-05	6.5E+01	4.8E+00	---		
371	>10-12 C aromatics (TPH)	l	---	O	130	1.4E-01	3.4	------	1.0E-01	1.0E-05	2.5E+01	4.8E-01	---		
375	>12-16 C aromatics (TPH)	l	---	O	150	5.3E-02	3.7	------	1.0E-01	1.0E-05	5.8E+00	3.6E-02	---		
376	>16-21 C aromatics (TPH)	l	---	O	190	1.3E-02	4.2	------	1.0E-01	1.0E-05	6.5E-01	8.4E-04	---		
377	>21-35 C aromatics (TPH)	s	---	O	240	6.7E-04	5.1	------	1.0E-01	1.0E-05	6.6E-03	3.3E-07	---		

Legend

s	compound solid at @ 20 °C	D_{air}	Diffusion coefficient in air (cm^2/s)
l	compound liquid at @ 20 °C	D_{wat}	Diffusion coefficient in water (cm^2/s)
g	compound gaseous at @ 20 °C	K_{ow}	Octanol-water partition coefficient (cm^3-H_2O/cm^3-Octanol)
H'	Dimensionless Henry's Law Constant H' = H x 41.57 @ 20 °C (cm^3-H_2O/cm^3-air)	Br_{Abg}	Soil-to-above ground plant biotransfer factor (g soil/g plant tissue dry weight)

	COMPOUND	Phys-ical State	CAS number	Type	M.W. (g/mole)	H ' (cm^3-H_2O/cm^3-air)	$LogK_{oc}$	Log K_d	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	Solubility (mg/l)	Vapor Pressure (mm Hg)	Log K_{ow}	Br_{Abg} (g soil/g D.W.)	Br_{Bg} (g soil/g D.W.)

H	Henry's Law Constant (atm-m^3/mole)	Br_{Bg}	Soil-to-below ground plant biotransfer factor (g soil/g plant tissue dry weight)
MW	Molecular Weight (g/mole)	Type	O: Organic, I: Inorganic, M: Metal, OA: Organic Acids
K_{oc}	Soil organic carbon-water partition coefficient (cm^3-H_2O/g-Carbon)	CE	Not found, Can not estimate
K_d	Soil-water partition coefficient (cm^3-H_2O/g-Soil)	NA/reacts	Not applicable because reacts with water
		Values in italic	Estimated by TCEQ

(1) For Tiers 2 and 3, the person may determine property-specific soil pH in order to account for the high pH dependence of the soil-water partition coefficient (K_d) of inorganic compounds and the organic carbon-water partition coefficient (K_{oc}) of ionizing organic compounds. Once the property-specific pH is determined, the person shall apply subparagraphs (A) - (C) of this paragraph as applicable to determine pH-dependent K_d and K_{oc} values unless another appropriate method is approved by the executive director. The executive director may also approve the use of data from appropriately-conducted tests in determining a site-specific K_d or K_{oc}.

(A) For aluminum and lead, the person shall select a K_d from the following figure in accordance with the pH range and the total weight percent of clay, organic matter, iron, and aluminum oxyhydroxide representative of the affected property soils.

Soil-Water Distribution Coefficients (K_d) for Aluminum and Lead

	pH ≤ 5			pH 5-9			pH ≥9		
	Sandy Soil	Loamy Soil	Clayey Soil	Sandy Soil	Loamy Soil	Clayey Soil	Sandy Soil	Loamy Soil	Clayey Soil
Aluminum	3,980	3,980	44,600	35,300	35,300	35,300	353	353	353
Lead	10	10	12	234	597	1,830	234	597	1,830

Sandy Soil: <10% by weight clay, organic matter, and iron and aluminum oxyhydroxides.
Loamy Soil: 10-30% by weight clay, organic matter, and iron and aluminum oxyhydroxides.
Clayey Soil: >30% by weight clay, organic matter, and iron and aluminum oxyhydroxides.

(B) The person shall use the following figure to determine the pH-dependent K_{oc} value for the ionizing organic COCs listed.

K_{oc} Values for Ionizing Organic COCs as a Function of pH									
pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	2,4 - Dinitro-phenol	Penta-chloro-phenol	2,3,4,5-Tetra-chloro-phenol	2,3,4,6-Tetra-chloro-phenol	2,4,5-Tri-chloro-phenol	2,4,6-Tri-chloro-phenol
4.9	5.54E+00	3.98E+02	1.59E+02	2.94E-02	9.05E+03	1.73E+04	4.45E+03	2.37E+03	1.04E+03
5.0	4.64E+00	3.98E+02	1.59E+02	2.55E-02	7.96E+03	1.72E+04	4.15E+03	2.36E+03	1.03E+03
5.1	3.88E+00	3.98E+02	1.59E+02	2.23E-02	6.93E+03	1.70E+04	3.83E+03	2.36E+03	1.02E+03
5.2	3.25E+00	3.98E+02	1.59E+02	1.98E-02	5.97E+03	1.67E+04	3.49E+03	2.35E+03	1.01E+03
5.3	2.72E+00	3.98E+02	1.59E+02	1.78E-02	5.10E+03	1.65E+04	3.14E+03	2.34E+03	9.99E+02
5.4	2.29E+00	3.98E+02	1.58E+02	1.62E-02	4.32E+03	1.61E+04	2.79E+03	2.33E+03	9.82E+02
5.5	1.94E+00	3.97E+02	1.58E+02	1.50E-02	3.65E+03	1.57E+04	2.45E+03	2.32E+03	9.62E+02
5.6	1.65E+00	3.97E+02	1.58E+02	1.40E-02	3.07E+03	1.52E+04	2.13E+03	2.31E+03	9.38E+02
5.7	1.42E+00	3.97E+02	1.58E+02	1.32E-02	2.58E+03	1.47E+04	1.83E+03	2.29E+03	9.10E+02
5.8	1.24E+00	3.97E+02	1.58E+02	1.25E-02	2.18E+03	1.40E+04	1.56E+03	2.27E+03	8.77E+02
5.9	1.09E+00	3.97E+02	1.57E+02	1.20E-02	1.84E+03	1.32E+04	1.32E+03	2.24E+03	8.39E+02
6.0	9.69E-01	3.96E+02	1.57E+02	1.16E-02	1.56E+03	1.24E+04	1.11E+03	2.21E+03	7.96E+02
6.1	8.75E-01	3.96E+02	1.57E+02	1.13E-02	1.33E+03	1.15E+04	9.27E+02	2.17E+03	7.48E+02
6.2	7.99E-01	3.96E+02	1.56E+02	1.10E-02	1.15E+03	1.05E+04	7.75E+02	2.12E+03	6.97E+02
6.3	7.36E-01	3.95E+02	1.55E+02	1.08E-02	9.98E+02	9.51E+03	6.47E+02	2.06E+03	6.44E+02
6.4	6 89E-01	3.94E+02	1.54E+02	1.06E-02	8.77E+02	8.48E+03	5.42E+02	1.99E+03	5.89E+02
6.5	6.51E-01	3.93E+02	1.53E+02	1.05E-02	7.81E+02	7.47E+03	4.55E+02	1.91E+03	5.33E+02
6.6	6.20E-01	3.92E+02	1.52E+02	1.04E-02	7.03E+02	6.49E+03	3.84E+02	1.82E+03	4.80E+02
6.7	5.95E-01	3.90E+02	1.50E+02	1.03E-02	6.40E+02	5.58E+03	3.27E+02	1.71E+03	4.29E+02
6.8	5.76E-01	3.88E+02	1.47E+02	1.02E-02	5.92E+02	4.74E+03	2.80E+02	1.60E+03	3.81E+02
6.9	5.60E-01	3.86E+02	1.45E+02	1.02E-02	5.52E+02	3.99E+03	2.42E+02	1.47E+03	3.38E+02
7.0	5.47E-01	3.83E+02	1.41E+02	1.02E-02	5.21E+02	3.33E+03	2.13E+02	1.34E+03	3.00E+02
7.1	5.38E-01	3.79E+02	1.38E+02	1.02E-02	4.96E+02	2.76E+03	1.88E+02	1.21E+03	2.67E+02
7.2	5.32E-01	3.75E+02	1.33E+02	1.01E-02	4.76E+02	2.28E+03	1.69E+02	1.07E+03	2.39E+02
7.3	5.25E-01	3.69E+02	1.28E+02	1.01E-02	4.61E+02	1.87E+03	1.53E+02	9.43E+02	2.15E+02
7.4	5.19E-01	3.62E+02	1.21E+02	1.01E-02	4.47E+02	1.53E+03	1.41E+02	8.19E+02	1.95E+02
7.5	5.16E-01	3.54E+02	1.14E+02	1.01E-02	4.37E+02	1.25E+03	1.31E+02	7.03E+02	1.78E+02
7.6	5.13E-01	3.44E+02	1.07E+02	1.01E-02	4.29E+02	1.02E+03	1.23E+02	5.99E+02	1.64E+02
7.7	5.09E-01	3.33E+02	9.84E+01	1.00E-02	4.23E+02	8.31E+02	1.17E+02	5.07E+02	1.53E+02
7.8	5.06E-01	3.19E+02	8.97E+01	1.00E-02	4.18E+02	6.79E+02	1.13E+02	4.26E+02	1.44E+02
7.9	5.06E-01	3.04E+02	8.07E+01	1.00E-02	4.14E+02	5.56E+02	1.08E+02	3.57E+02	1.37E+02
8.0	5.06E-01	2.86E+02	7.17E+01	1.00E-02	4.10E+02	4.58E+02	1.05E+02	2.98E+02	1.31E+02

(C) The person shall use the following figure to determine the pH-dependent K_d value for the inorganic COCs listed.

K_d Values (L/kg) for Inorganic COCs as a Function of pH[a]													
pH	Sb	As	Ba	Be	Cd	Cr (3)	Cr(6)	Hg	Ni	Ag	Se	Tl	Zn
4.9	9.6E+01	2.5E+01	1.1E+01	2.3E+01	1.5E+01	1.2E+03	3.1E+01	4.0E-02	1.6E+01	1.0E-01	1.8E+01	4.4E+01	1.6E+01
5.0	9.1E+01	2.5E+01	1.2E+01	2.6E+01	1.7E+01	1.9E+03	3.1E+01	6.0E-02	1.8E+01	1.3E-01	1.7E+01	4.5E+01	1.8E+01
5.1	8.7E+01	2.5E+01	1.4E+01	2.8E+01	1.9E+01	3.0E+03	3.0E+01	9.0E-02	2.0E+01	1.6E-01	1.6E+01	4.6E+01	1.9E+01
5.2	8.3E+01	2.6E+01	1.5E+01	3.1E+01	2.1E+01	4.9E+03	2.9E+01	1.4E-01	2.2E+01	2.1E-01	1.5E+01	4.7E+01	2.1E+01
5.3	7.9E+01	2.6E+01	1.7E+01	3.5E+01	2.3E+01	8.1E+03	2.8E+01	2.0E-01	2.4E+01	2.6E-01	1.4E+01	4.8E+01	2.3E+01
5.4	7.6E+01	2.6E+01	1.9E+01	3.8E+01	2.5E+01	1.3E+04	2.7E+01	3.0E-01	2.6E+01	3.3E-01	1.3E+01	5.0E+01	2.5E+01
5.5	7.2E+01	2.6E+01	2.1E+01	4.2E+01	2.7E+01	2.1E+04	2.7E+01	4.6E-01	2.8E+01	4.2E-01	1.2E+01	5.1E+01	2.6E+01
5.6	6.9E+01	2.6E+01	2.2E+01	4.7E+01	2.9E+01	3.5E+04	2.6E+01	6.9E-01	3.0E+01	5.3E-01	1.1E+01	5.2E+01	2.8E+01
5.7	6.5E+01	2.7E+01	2.4E+01	5.3E+01	3.1E+01	5.5E+04	2.5E+01	1.0E+00	3.2E+01	6.7E-01	1.1E+01	5.4E+01	3.0E+01
5.8	6.2E+01	2.7E+01	2.6E+01	6.0E+01	3.3E+01	8.7E+04	2.5E+01	1.6E+00	3.4E+01	8.4E-01	9.8E+00	5.5E+01	3.2E+01
5.9	6.0E+01	2.7E+01	2.8E+01	6.9E+01	3.5E+01	1.3E+05	2.4E+01	2.3E+00	3.6E+01	1.1E+00	9.2E+00	5.6E+01	3.4E+01
6.0	5.7E+01	2.7E+01	3.0E+01	8.2E+01	3.7E+01	2.0E+05	2.3E+01	3.5E+00	3.8E+01	1.3E+00	8.6E+00	5.8E+01	3.6E+01
6.1	5.4E+-01	2.7E+01	3.1E+01	9.9E+01	4.0E+01	3.0E+05	2.3E+01	5.1E+00	4.0E+01	1.7E+00	8.0E+00	5.9E+01	3.9E+01
6.2	5.2E+01	2.8E+01	3.3E+01	1.2E+02	4.2E+01	4.2E+05	2.2E+01	7.5E+00	4.2E+01	2.1E+00	7.5E+00	6.1E+01	4.2E+01
6.3	4.9E+01	2.8E+01	3.5E+01	1.6E+02	4.4E+01	5.8E+05	2.2E+01	1.1E+01	4.5E+01	2.7E+00	7.0E+00	6.2E+01	4.4E+01
6.4	4.7E+01	2.8E+01	3.6E+01	2.1E+02	4.8E+01	7.7E+05	2.1E+01	1.6E+01	4.7E+01	3.4E+00	6.5E+00	6.4E+01	4.7E+01
6.5	4.5E+01	2.8E+01	3.7E+01	2.8E+02	5.2E+01	9.9E+05	2.0E+01	2.2E+01	5.0E+01	4.2E+00	6.1E+00	6.6E+01	5.1E+01
6.6	4.3E+01	2.8E+01	3.9E+01	3.9E+02	5.7E+01	1.2E+06	2.0E+01	3.0E+01	5.4E+01	5.3E+00	5.7E+00	6.7E+01	5.4E+01
6.7	4.1E+01	2.9E+01	4.0E+01	5.5E+02	6.4E+01	1.5E+06	1.9E+01	4.0E+01	5.8E+01	6.6E+00	5.3E+00	6.9E+01	5.8E+01
6.8	3.9E+01	2.9E+01	4.1E+01	7.9E+02	7.5E+01	1.8E+06	1.9E+01	5.2E+01	6.5E+01	8.3E+00	5.0E+00	7.1E+01	6.2E+01
6.9	3.7E+01	2.9E+01	4.2E+01	1.1E+03	9.1E+01	2.1E+06	1.8E+01	6.6E+01	7.4E+01	1.0E+01	4.7E+00	7.3E+01	6.8E+01
7.0	3.5E+01	2.9E+01	4.2E+01	1.7E+03	1.1E+02	2.5E+06	1.8E+01	8.2E+01	8.8E+01	1.3E+01	4.3E+00	7.4E+01	7.5E+01
7.1	3.4E+01	2.9E+01	4.3E+01	2.5E+03	1.5E+02	2.8E+06	1.7E+01	9.9E+01	1.1E+02	1.6E+01	4.1E+00	7.6E+01	8.3E+01
7.2	3.2E+01	3.0E+01	4.4E+01	3.8E+03	2.0E+02	3.1E+06	1.7E+01	1.2E+02	1.4E+02	2.0E+01	3.8E+00	7.8E+01	9.5E+01
7.3	3.1E+01	3.0E+01	4.4E+01	5.7E+03	2.8E+02	3.4E+06	1.6E+01	1.3E+02	1.8E+02	2.5E+01	3.5E+00	8.0E+01	1.1E+02
7.4	2.9E+01	3.0E+01	4.5E+01	8.6E+03	4.0E+02	3.7E+06	1.6E+01	1.5E+02	2.5E+02	3.1E+01	3.3E+00	8.2E+01	1.3E+02
7.5	2.8E+01	3.0E+01	4.6E+01	1.3E+04	5.9E+02	3.9E+06	1.6E+01	1.6E+02	3.5E+02	3.9E+01	3.1E+00	8.5E+01	1.6E+02
7.6	2.6E+01	3.1E+01	4.6E+01	2.0E+04	8.7E+02	4.1E+06	1.5E+01	1.7E+02	4.9E+02	4.8E+01	2.9E+00	8.7E+01	1.9E+02
7.7	2.5E+01	3.1E+01	4.7E+01	3.0E+04	1.3E+03	4.2E+06	1.5E+01	1.8E+02	7.0E+02	5.9E+01	2.7E+00	8.9E+01	2.4E+02
7.8	2.4E+01	3.1E+01	4.9E+01	4.6E+04	1.9E+03	4.3E+06	1.4E+01	1.9E+02	9.9E+02	7.3E+01	2.5E+00	9.1E+01	3.1E+02
7.9	2.3E+01	3.1E+01	5.0E+01	6.9E+04	2.9E+03	4.3E+06	1.4E+01	1.9E+02	1.4E+03	8.9E+01	2.4E+00	9.4E+01	4.0E+02
8.0	2.2E+01	3.1E+01	5.2E+01	1.0E+05	4.3E+03	4.3E+06	1.4E+01	2.0E+02	1.9E+03	1.1E+02	2.2E+00	9.6E+01	5.3E+02

[a] non pH-dependent inorganic K_d values for cyanide, and vanadium are 9.9, and 50 respectively.

(2) For Tiers 2 and 3, the person may establish alternate soil-to-plant biotransfer factors (Br_{abg} and Br_{bg}) by establishing the pH of the soil and the soil type, and then identifying a biotransfer factor in the published literature appropriate for those soil conditions. Alternatively, the person can measure the biotransfer factor in accordance with procedures acceptable to the executive director.

Adopted February 21, 2007 Effective March 19, 2007

§350.74. Development of Risk-Based Exposure Limits.

(a) General requirement. The person shall use the criteria provided in subsections (b) - (j) of this section and the RBEL equations provided in the following figures, as applicable, to establish RBELs appropriate for the type of COC, the complete and reasonably anticipated to be completed exposure pathways, receptors, and land uses. The person shall establish RBELs for carcinogenic COCs and noncarcinogenic COCs using the default exposure factors provided in the following figure for residents and commercial/industrial workers, unless the executive director approves the use of alternate exposure factors in accordance with subsection (j) of this section.

Risk-Based Exposure Limit Equations and Default Exposure Factors for Residents

RBEL-1:
Inhalation of carcinogenic COCs - RBEL (mg/m^3)

$$^{Air}RBEL_{Inh\text{-}c} = \frac{RL \times ATc \times 365\ days/yr}{URF \times 1000\ \mu g/mg \times EF.res \times ED.A.res}$$

Inhalation of noncarcinogenic COCs - RBEL (mg/m^3)

$$^{Air}RBEL_{Inh\text{-}nc} = \frac{RfC \times HQ \times AT.A.res \times 365\ days/yr}{EF.res \times ED.A.res}$$

RBEL-2:
Dermal contact with carcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Derm\text{-}c} = \frac{RL \times ATc \times 365\ days/yr}{SF_d \times MF \times 10^{-6}\ kg/mg \times EF.res \times DF.adj \times ABS.d}$$

where: $SF_d = \frac{SF_o}{ABS_{GI}}$ when ABS_{GI} <50%, otherwise $SF_d = SF_o$; and

$$DF.adj = \frac{(SA_{0<6})(AF_{0<6})(ED_{0<6})}{(BW_{0<6})} + \frac{(SA_{6<18})(AF_{6<18})(ED_{6<18})}{(BW_{6<18})} + \frac{(SA_{18<30})(AF_{18<30})(ED_{18<30})}{(BW_{18<30})}$$

Dermal contact with noncarcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Derm\text{-}nc} = \frac{HQ \times RfD_d \times BW.C \times AT.C.res \times 365\ days/yr}{10^{-6}\ kg/mg \times ED.C.res \times EF.res \times SA.C.res \times AF.C.res \times ABS.d}$$

where $RfD_d = (RfD_o)\ (ABS_{GI})$ when ABS_{GI} <50%, otherwise $RfD_d = RfD_o$

RBEL-3:
Ingestion of carcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Ing\text{-}c} = \frac{RL \times ATc \times 365\ days/yr}{SF_o \times MF \times 10^{-6}\ kg/mg \times EF.res \times IRsoil.AgeAdj.res \times RBAF}$$

Ingestion of noncarcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Ing\text{-}nc} = \frac{HQ \times BW.C \times RfD_o \times AT.C.res \times 365\ days/yr}{10^{-6}\ kg/mg \times EF.res \times ED.C.res \times IRsoil.C.res \times RBAF}$$

RBEL-5:
Class 3 Groundwater RBEL

$$^{GW}RBEL_{Class\ 3} = 100 \times RBEL\text{-}4$$

RBEL-7:
Ingestion of carcinogenic COCs in above-ground vegetables - RBEL (mg/kg)

$$^{AbgVeg}RBEL_{Ing\text{-}c} = \frac{RL \times ATc \times 365\ day/yr}{EF.res \times SF_o \times MF \times IRabg.AgeAdj.res}$$

Ingestion of noncarcinogenic COCs in above-ground vegetables - RBEL (mg/kg)

$$^{AbgVeg}RBEL_{Ing\text{-}nc} = \frac{HQ \times RfD_o \times BW.C \times AT.C.res \times 365\ day/yr}{EF.res \times ED.C.res \times IRabg.C.res}$$

Ingestion of carcinogenic COCs in below-ground vegetables - RBEL (mg/kg)

$$^{BgVeg}RBEL_{Ing\text{-}c} = \frac{RL \times ATc \times 365\ day/yr}{EF.res \times SF_o \times MF \times IRbg.AgeAdj.res}$$

Ingestion of noncarcinogenic COCs in below-ground vegetables - RBEL (mg/kg)

$$^{BgVeg}RBEL_{Ing\text{-}nc} = \frac{HQ \times RfD_o \times BW.C \times AT.C.res \times 365\ day/yr}{EF.res \times ED.C.res \times IRbg.C.res}$$

Risk-Based Exposure Limit Equations and Default Exposure Factors for Residents	
RBEL-4: Ingestion of carcinogenic COCs in water - RBEL (mg/L) $^{GW}RBEL_{Ing\text{-}c}$ = primary MCL when available, or a secondary MCL under the conditions described in §350.74(f)(3), otherwise $\frac{RL \times AT_c \times 365\ days/yr}{SF_o \times MF \times IRw.AgeAdj.res \times EF.res}$ Ingestion of noncarcinogenic COCs in water - RBEL (mg/L) $^{GW}RBEL_{Ing\text{-}nc}$ = primary MCL when available, or a secondary MCL under the conditions described in §350.74(f)(3), otherwise $\frac{RfD_o \times HQ \times BW.C \times AT.C.res \times 365\ days/yr}{IRw.C.res \times EF.res \times ED.C.res}$	RBEL-6: Surface Water RBEL $^{SW}RBEL$ =the lowest value of each COC established under §350.74(h)(1) - (5), unless the person has sufficient property-specific surface water quality information specific to the particular surface water body at the affected property to support an adjustment to the RBEL in accordance with §350.74(h)(6). $^{SW}RBEL$ determined pursuant to §350.74(h)(1) - (5) may require modification in response to §350.74(h)(7) - (8).

Risk-Based Exposure Limit Equations and Default Exposure Factors for Residents				
Term	Exposure Factor	Default Exposure Factor	Change to Default Exposure Factor Allowed?	Citation for Change
ABS.d**	Dermal Absorption Fraction (unitless)	(Figure: 30 TAC §350.74(c))	Tier 2/3	§350.74(j)(1)(B)
ABS_{GI}	Gastrointestinal Absorption Fraction (unitless)	(Figure: 30 TAC §350.74(c))	Tier 2/3	§350.74(j)(1)(A)
AF.C.res	Soil-to-Skin Adherence Factor (mg/cm^2-event) - Child	0.2	No	NA
$AF_{(0<6)}$	Age-Specific Adherence Factor (mg/cm^2-event)	0.2	No	NA
$AF_{(6<18)}$	Age-Specific Adherence Factor (mg/cm^2-event)	0.1	No	NA
$AF_{(18<30)}$	Age-Specific Adherence Factor (mg/cm^2-event)	0.1	No	NA
AT.A.res	Averaging Time - noncarcinogens (yr)-Adult	30	No	NA
ATc	Averaging Time - carcinogens (yr)	70	No	NA
AT.C.res	Averaging Time - noncarcinogens (yr) -Child	6	No	NA
BW.C	Body Weight (kg) - Child	15	No	NA
$BW_{(0<6)}$	Age-Specific Body Weight (kg)	15	No	NA
$BW_{(6<18)}$	Age-Specific Body Weight (kg)	45	No	NA
$BW_{(18<30)}$	Age-Specific Body Weight (kg)	70	No	NA
DF.adj	Dermal Adjustment Factor (mg-yr/kg-event)	352	No	NA
ED.A.res	Exposure Duration (yr) - Adult	30	No	NA
ED.C.res	Exposure Duration (yr) - Child	6	No	NA
$ED_{(0<6)}$	Age-Specific Exposure Duration (yr)	6	No	NA
$ED_{(6<18)}$	Age-Specific Exposure Duration (yr)	12	No	NA
$ED_{(18<30)}$	Age-Specific Exposure Duration (yr)	12	No	NA
EF.res	Exposure Frequency (days/yr) (event/yr for dermal soil)	350	No	NA
HQ	Hazard Quotient (unitless)	1	No	NA
IRsoil.AgeAdj.res	Age-Adjusted Soil Ingestion Rate (mg-yr/kg-day)	120	No	NA
IRsoil.C.res	Soil Ingestion Rate (mg/day) - Child	191	No	NA
IRw.AgeAdj.res	Age-Adjusted Water Ingestion Rate (L-yr/kg-day)	0.80	No	NA
IRw.C.res	Water Ingestion Rate (L/Day) - Child	0.64	No	NA
MF	Modifying Factor for SFo (unitless)	1	No	NA
	for Arsenic	0.1	No	
RBAF	Relative Bioavailability Factor (unitless)	1	Tier 2/3	§350.74(j)(1)(C)
	for Arsenic	0.78	Tier 2/3	§350.74(j)(1)(C)
RfC*	Reference Concentration (mg/m^3)	Chemical Specific	NA	§350.73 (a) and (c)
RfD_o	Oral Reference Dose (mg/kg-day)	Chemical Specific	NA	§350.73(a)
RfD_d	Dermal Reference Dose (mg/kg-day)	Chemical Specific	NA	§350.73(a)

Risk-Based Exposure Limit Equations and Default Exposure Factors for Residents					
Term	Exposure Factor		Default Exposure Factor	Change to Default Exposure Factor Allowed?	Citation for Change
RL	Risk Level (unitless)		10^{-5}	No	NA
SA.C.res	Skin Surface Area (cm^2)- Child		2200	No	NA
$SA_{(0<6)}$	Age-specific Skin Surface Area (cm^2)		2200	No	NA
$SA_{(6<18)}$	Age-specific Skin Surface Area (cm^2)		3500	No	NA
$SA_{(18<30)}$	Age-specific Skin Surface Area (cm^2)		4800	No	NA
SF_d	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$		Chemical Specific	NA	§350.73(a)
SF_o	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$		Chemical Specific	NA	§350.73(a)
URF*	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$		Chemical Specific	NA	§350.73 (a) and (c)
Vegetable Ingestion Rate - Age-Adjusted (kg-yr/kg-day)					
	IRabg.AgeAdj.res	Aboveground Vegetables	0.0028	No	NA
	IRbg.AgeAdj.res	Below-Ground Vegetables	0.0012	No	NA
Vegetable Ingestion Rate - Child (kg/day)					
	IRabg.C.res	Aboveground Vegetables	0.0024	No	NA
	IRbg.C.res	Below-Ground Vegetables	0.0010	No	NA

Footnote:
* When no RfC or URF is available, then the person shall use the most current TCEQ Chronic Remediation-Specific Effects Screening Level value as the RfC unless §350.73(b) applies.
** It is not necessary to calculate a soil dermal contact RBEL for COCs with a vapor pressure in mm HG $\geq$ 1.
NA means not applicable.

Risk Based Exposure Limit Equations and Default Exposure Factors for Commercial/Industrial Worker	
RBEL-1: Inhalation of carcinogenic COCs - RBEL (mg/m^3) $^{Air}RBEL_{Inh\text{-}c} = \frac{RL \times ATc \times 365\ days/yr}{URF \times 1000\ \mu g/mg \times EF.w \times ED.w}$ Inhalation of noncarcinogenic COCs - RBEL (mg/m^3) $^{Air}RBEL_{Inh\text{-}nc} = \frac{RfC \times HQ \times AT.w \times 365\ days/yr}{EF.w \times ED.w}$	RBEL-4: Ingestion of carcinogenic COCs in water - RBEL (mg/L) $^{GW}RBEL_{Ing\text{-}c}$ = primary MCL when available, or a secondary MCL under the conditions described in §350.74(f)(3), otherwise $\frac{RL \times BW.A \times ATc \times 365\ days/yr}{SF_o \times MF \times IRw.w \times EF.w \times ED.w}$ Ingestion of noncarcinogenic COCs in water - RBEL (mg/L) $^{GW}RBEL_{Ing\text{-}nc}$ = primary MCL when available, or a secondary MCL under the conditions described in §350.74(f)(3), otherwise $\frac{RfD_o \times HQ \times BW.A \times AT.w \times 365\ days/yr}{IRw.w \times EF.w \times ED.w}$
RBEL-2: Dermal contact with carcinogenic COCs in soil - RBEL (mg/kg) $^{Soil}RBEL_{Derm\text{-}c} = \frac{RL \times BW.A \times ATc \times 365\ days/yr}{SF_d \times MF \times 10^{-6}\ kg/mg \times ED.w \times EF.w \times SA.w \times AF.w \times ABS.d}$ where: $SF_d = \frac{SF_o}{ABS_{GI}}$ when ABS_{GI} <50%, otherwise $SF_d = SF_o$ Dermal contact with noncarcinogenic COCs in soil - RBEL (mg/kg) $^{Soil}RBEL_{Derm\text{-}nc} = \frac{HQ \times RfD_d \times BW.A \times AT.w \times 365\ days/yr}{10^{-6}\ kg/mg \times ED.w \times EF.w \times SA.w \times AF.w \times ABS.d}$ where $RfD_d = (RfD_o)\ (ABS_{GI})$ when ABS_{GI} <50%, otherwise $RfD_d = RfD_o$	RBEL-5: Class 3 groundwater RBEL $^{GW}RBEL_{Class3} = 100 \times$ RBEL-4

Risk-Based Exposure Limit Equations and Default Exposure Factors for Commercial/Industrial Worker

RBEL-3:
Ingestion of carcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Ing\text{-}c} = \frac{RL \times BW.A \times AT_c \times 365\ days/yr}{SF_o \times MF \times 10^{-6}\ kg/mg \times EF.w \times ED.w \times IRsoil.w \times RBAF}$$

Ingestion of noncarcinogenic COCs in soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Ing\text{-}nc} = \frac{HQ \times BW.A \times RfD_o \times AT.w \times 365\ days/yr}{10^{-6}\ kg/mg \times EF.w \times ED.w \times IRsoil.w \times RBAF}$$

RBEL-6: Surface Water RBEL

^{SW}RBEL =the lowest value of each COC established under §350.74(h)(1) - (5), unless the person has sufficient property-specific surface water quality information specific to the particular surface water body at the affected property to support an adjustment to the RBEL in accordance with §350.74(h)(6). ^{SW}RBEL determined pursuant to §350.74(h)(1) - (5) may require modification in response to §350.74(h)(7) - (8).

Risk-Based Exposure Limit Equations and Default Exposure Factors for Commercial/Industrial Worker

Term	Exposure Factor	Default Exposure Factor	Change to Default Exposure Factor Allowed?	Citation for Change
ABS.d**	Dermal Absorption Fraction (unitless)	(Figure: 30 TAC §350.74(c))	Tier 2/3	§350.74(j)(1)(B)
ABS_{GI}	Gastrointestinal Absorption Fraction (unitless)	(Figure: 30 TAC §350.74(c))	Tier 2/3	§350.74(j)(1)(A)
AF.w	Soil-to-Skin Adherence Factor (mg/cm^2-event)	0.2	No	NA
ATc	Averaging Time - carcinogens (yr)	70	No	NA
AT.w	Averaging Time - noncarcinogens (yr)	25	Tier 2/3	§350.74(j)(2)
BW.A	Body Weight, adult (kg)	70	No	NA
ED.w	Exposure Duration (yr)	25	Tier 2/3	§350.74(j)(2)
EF.w	Exposure Frequency (days/yr) (event/yr for dermal soil)	250	Tier 2/3	§350.74(j)(2)
HQ	Hazard Quotient (unitless)	1	No	NA
IRsoil.w	Soil Ingestion Rate (mg/day)	100	No	NA
IRw.w	Water Ingestion Rate (L/day)	1.4	No	NA
MF	Modifying Factor for SF_o (unitless)	1	No	NA
	for Arsenic	0.1	No	NA
RBAF	Relative Bioavailability Factor (unitless)	1	Tier 2/3	§350.74(j)(1)(D)
	for Arsenic	0.78	Tier 2/3	§350.74(j)(1)(D)
RfC*	Reference Concentration (mg/m^3)	Chemical-Specific	NA	§350.73 (a) and (c)
RfD_o	Oral Reference Dose (mg/kg-day)	Chemical-Specific	NA	§350.73(a)
RfD_d	Dermal Reference Dose (mg/kg-day)	Chemical-Specific	NA	§350.73(a)
RL	Risk Level (unitless)	10^{-5}	No	NA
SA.w	Skin Surface Area (cm^2)	2500	No	NA
SF_d	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	NA	§350.73(a)
SF_o	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	NA	§350.73(a)
URF*	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$	Chemical-Specific	NA	§350.73 (a) and (c)

Footnote:
* When no RfC or URF is available, then the person shall use the most current TCEQ Chronic Remediation-Specific Effects Screening Level value as the RfC unless §350.73(b) applies.
** It is not necessary to calculate a soil dermal contact RBEL for COCs with a vapor pressure in mm HG $\geq$ 1.
NA means not applicable.

(b) Air inhalation RBEL. The air inhalation RBEL ($^{Air}RBEL_{Inh}$) is the protective concentration of a COC in air at the POE for human inhalation.

(1) Under Tiers 2 and 3 as described in §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), the person may use the lower of available eight hour time-weighted average occupational inhalation criteria; (i.e., Occupational Safety and Health Administration Permissible Exposure Limits, or American Conference of Governmental Industrial Hygienists Threshold Limit Values), as $^{Air}RBEL_{Inh}$ for inhalation pathways for commercial/industrial workers within the limits of affected commercial/industrial properties which have a health and safety plan in place. The health and safety plan shall be designed to ensure compliance with the applicable occupational inhalation criteria and require the monitoring of COC levels in the working air environment, and specify actions that will be taken in the event of exceedance of the occupational inhalation criteria. When occupational inhalation criteria are used, the person shall provide documentation of the health and safety plan, certify that the plan is followed, and demonstrate that the off-site receptors are protected as required by §350.71(h) of this title (relating to General Requirements). The use of occupational inhalation criteria as RBELs shall require the person to comply with the institutional control requirements in §350.111(b) and (b)(14) of this title (relating to Use of Institutional Controls).

(2) The air RBELs may not exceed any other applicable federal or state air quality standards.

(c) Soil dermal contact RBEL. The soil dermal contact RBEL ($^{Soil}RBEL_{Derm}$) is the protective concentration of a COC at the POE in soil based upon direct dermal contact to soil by humans. The soil dermal contact RBEL shall also be based on COC-specific values for dermal absorption fraction (ABS.d) and gastrointestinal absorption fraction (ABS_{GI}) provided in the following figure, unless the executive director approves the use of alternate ABS.d and ABS_{GI} values in accordance with subsection (j)(1)(A) and (B) of this section. It is not necessary to calculate a soil dermal contact RBEL for COCs with vapor pressure in mm of Hg greater than or equal to 1.

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
Acenaphthene	83-32-9	8.90E-01	1.30E-01
Acenaphthylene	208-96-8	8.90E-01	1.30E-01
Acetone cyanohydrin	75-86-5	5.00E-01	1.00E-01
Acetophenone	98-86-2	5.00E-01	1.00E-01
Acifluorfen, sodium	62476-59-9	5.00E-01	1.00E-01
Acrylamide	79-06-1	5.00E-01	1.00E-01
Alachlor	15972-60-8	5.00E-01	1.00E-01
Aldicarb	116-06-3	5.00E-01	1.00E-01
Aldicarb sulfone	1646-88-4	5.00E-01	1.00E-01
Aldrin	309-00-2	5.00E-01	1.00E-01
Aluminum	7429-90-5	1.00E-01	1.00E-02
Aminopyridine, 4-	504-24-5	5.00E-01	1.00E-01
Ammonia	7664-41-7	2.00E-01	1.00E-02
Aniline	62-53-3	5.00E-01	1.00E-01
Anthracene	120-12-7	8.90E-01	1.30E-01
Antimony	7440-36-0	1.50E-01	1.00E-02
Aramite	140-57-8	5.00E-01	1.00E-01
Arsenic	7440-38-2	9.50E-01	3.00E-02
Arsine	7784-42-1	2.00E-01	1.00E-02
Asbestos	1332-21-4	2.00E-01	1.00E-02
Atrazine	1912-24-9	5.00E-01	1.00E-01
Barium	7440-39-3	7.00E-01	1.00E-02
Benzidine	92-87-5	8.00E-01	1.00E-01
Benz-a-anthracene	56-55-3	8.90E-01	1.30E-01
Benzo-a-pyrene	50-32-8	8.90E-01	1.30E-01
Benzo-b-fluoranthene	205-99-2	8.90E-01	1.30E-01
Benzo-k-fluoranthene	207-08-9	8.90E-01	1.30E-01
Benzo-g,h,i-perylene	191-24-2	8.90E-01	1.30E-01
Benzoic acid	65-85-0	1.00E-01	1.00E-01
Benzotrichloride	98-07-7	5.00E-01	1.00E-01
Benzyl alcohol	100-51-6	6.60E-01	1.00E-01
Beryllium	7440-41-7	7.00E-03	1.00E-02
Biphenyl, 1,1-	92-52-4	5.00E-01	1.00E-01
Bis (2-chloroisopropyl) ether	108-60-1	5.00E-01	1.00E-01
Bis (2-ethyl-hexyl) phthalate	117-81-7	1.90E-01	1.00E-01
Butylate	2008-41-5	5.00E-01	1.00E-01
Butyl benzyl phthalate	85-68-7	6.10E-01	1.00E-01
Cacodylic acid	75-60-5	5.00E-01	1.00E-01
Cadmium	7440-43-9	2.50E-02	1.00E-02
Captan	133-06-2	5.00E-01	1.00E-01
Carbaryl	63-25-2	5.00E-01	1.00E-01

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
Carbazole	86-74-8	7.00E-01	1.00E-01
Carbofuran	1563-66-2	5.00E-01	1.00E-01
Carbosulfan	55285-14-8	5.00E-01	1.00E-01
Chlordane	57-74-9	8.00E-01	4.00E-02
Chlorine	7782-50-5	2.00E-01	1.00E-02
Chloroanaline, p-	106-47-8	5.00E-01	1.00E-01
Chlorobenzilate	510-15-6	5.00E-01	1.00E-01
Chloronaphthalene, 2-	91-58-7	8.90E-01	1.30E-01
Chlorpyrifos	2921-88-2	5.00E-01	1.00E-01
Chromium (III)/Chromium total	16065-83-1 / 7440-47-3	1.30E-02	1.00E-02
Chromium (VI)	18540-29-9	2.50E-02	1.00E-02
Chrysene	218-01-9	8.90E-01	1.30E-01
Cobalt	7440-48-4	8.00E-01	1.00E-02
Copper	7440-50-8	5.70E-01	1.00E-02
Cresol, m-	108-39-4	5.00E-01	1.00E-01
Cresol, o-	95-48-7	5.00E-01	1.00E-01
Cresol, p-	106-44-5	6.50E-01	1.00E-01
Cyanide	57-12-5	5.00E-01	1.00E-02
Cyclotrimethylenetrinitramine	121-82-4	1.00E+00	1.00E-01
Diethyl phthalate	84-66-2	9.00E-01	1.00E-01
Diethylstilbestrol	56-53-1	5.00E-01	1.00E-01
Dimethoate	60-51-5	5.00E-01	1.00E-01
Dimethoxybenzidine, 3,3'-	119-90-4	5.00E-01	1.00E-01
Dimethylbenzidine, 3,3'-	119-93-7	5.00E-01	1.00E-01
Dimethyl phenol, 2,4-	105-67-9	5.00E-01	1.00E-01
Dinitrobenzene, 1,3-	99-65-0	6.50E-01	1.00E-01
Dinitrobenzene, 1,4-	100-25-4	5.00E-01	1.00E-01
Dinitrophenol, 2,4-	51-28-5	1.00E+00	1.00E-01
Dinitrotoluene, 2,4-	121-14-2	8.50E-01	1.00E-01
Dinitrotoluene, 2,6-	606-20-2	8.50E-01	1.00E-01
Dinoseb	88-85-7	5.00E-01	1.00E-01
Diphenylamine	122-39-4	5.00E-01	1.00E-01

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
Diphenylhydrazine, 1,2-	122-66-7	5.00E-01	1.00E-01
Diquat	85-00-7	5.00E-01	1.00E-01
Disulfoton	298-04-4	5.00E-01	1.00E-01
Diuron	330-54-1	5.00E-01	1.00E-01
Endosulfan	115-29-7	5.00E-01	1.00E-01
Endothall	145-73-3	5.00E-01	1.00E-01
Endrin	72-20-8	5.00E-01	1.00E-01
Epichlorohydrin	106-89-8	8.00E-01	0.00E+00
Ethion	563-12-2	5.00E-01	1.00E-01
Ethyl dipropylthiocarbamate, S-	759-94-4	5.00E-01	1.00E-01
Ethylene glycol	107-21-1	5.00E-01	1.00E-01
Ethylene thiourea	96-45-7	5.00E-01	1.00E-01
Fluoranthene	206-44-0	8.90E-01	1.30E-01
Fluorene	86-73-7	8.90E-01	1.30E-01
Fluorine (soluble fluoride)	7782-41-4	9.70E-01	1.00E-02
Heptachlor	76-44-8	7.20E-01	1.00E-01
Heptachlor epoxide	1024-57-3	7.20E-01	1.00E-01
Hexachlorobenzene	118-74-1	5.00E-01	1.00E-01
Hexachlorobutadiene	87-68-3	5.00E-01	1.00E-01
Hexachlorocyclohexane, alpha	319-84-6	9.70E-01	4.00E-02
Hexachlorocyclohexane, beta	319-85-7	9.10E-01	4.00E-02
Hexachlorocyclohexane, gamma	58-89-9	9.70E-01	4.00E-02
Hexachlorocyclohexane, techn	608-73-1	9.70E-01	4.00E-02
Hexachlorocyclopentadiene	77-47-4	5.00E-01	1.00E-01
Hexachloroethane	67-72-1	5.00E-01	1.00E-01
Hexachlorophene	70-30-4	5.00E-01	1.00E-01
Hexazinone	51235-04-2	5.00E-01	1.00E-01
Indeno-1,2,3-cd-pyrene	193-39-5	8.90E-01	1.30E-01
Isophorone	78-59-1	5.00E-01	1.00E-01
Kepone	143-50-0	5.00E-01	1.00E-01
Lead (inorganic)	7439-92-1	---	---
Malathion	121-75-5	5.00E-01	1.00E-01
Maleic anhydride	108-31-6	5.00E-01	1.00E-01
Maleic hydrazide	123-33-1	5.00E-01	1.00E-01
Malononitrile	109-77-3	5.00E-01	1.00E-01

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
Manganese	7439-96-5	6.00E-02	1.00E-02
Mercury	7439-97-6	7.00E-02	1.00E-02
Methomyl	16752-77-5	5.00E-01	1.00E-01
Methoxychlor	72-43-5	5.00E-01	1.00E-01
Methyl mercury	22967-92-6	9.00E-01	1.00E-02
Methylnaphthalene, 2-	91-57-6	8.90E-01	1.30E-01
Methyl parathion	298-00-0	5.00E-01	1.00E-01
Methylene-bis (2-chloroaniline) 4,4'-	101-14-4	5.00E-01	1.00E-01
Molinate	2212-67-1	5.00E-01	1.00E-01
Molybdenum	7439-98-7	3.80E-01	1.00E-02
Naled	300-76-5	5.00E-01	1.00E-01
Naphthalene	91-20-3	8.90E-01	1.30E-01
Nickel and compounds (soluble salts)	7440-02-0	4.00E-02	1.00E-02
Nitrate	14797-55-8	5.00E-01	1.00E-02
Nitrite	14797-65-0	5.00E-01	1.00E-02
Nitroaniline, 2-	88-74-4	5.00E-01	1.00E-01
Nitrobenzene	98-95-3	9.70E-01	1.00E-01
Nitroso-n-ethylurea, n-	759-73-9	5.00E-01	1.00E-01
Nitrosodi-n-butylamine, n-	924-16-3	5.00E-01	1.00E-01
Nitrosodi-n-propylamine, n-	621-64-7	2.50E-01	1.00E-01
Nitrosodiethanolamine	1116-54-7	5.00E-01	1.00E-01
Nitrosodiphenylamine	86-30-6	2.50E-01	1.00E-01
Nitrosopyrrolidine, n-	930-55-2	5.00E-01	1.00E-01
Nitrotoluene, m-	99-08-1	5.00E-01	1.00E-01
Nitrotoluene, o-	88-72-2	5.00E-01	1.00E-01
Nitrotoluene, p-	99-99-0	5.00E-01	1.00E-01
Octamethylpyrophosphoramide	152-16-9	5.00E-01	1.00E-01
Oxamyl	23135-22-0	5.00E-01	1.00E-01
Parathion	56-38-2	5.00E-01	1.00E-01
Pebulate	1114-71-2	5.00E-01	1.00E-01
Pentachlorobenzene	608-93-5	5.00E-01	1.00E-01
Pentachloronitrobenzene	82-68-8	5.00E-01	1.00E-01
Pentachlorophenol	87-86-5	7.60E-01	2.50E-01
Phenanthrene	85-01-8	8.90E-01	1.30E-01
Phenol	108-95-2	9.00E-01	1.00E-01

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
Phenyl mercuric acetate	62-38-4	5.00E-01	1.00E-01
Phenylene diamine, m-	108-45-2	5.00E-01	1.00E-01
Phenylene diamine, p-	106-50-3	5.00E-01	1.00E-01
Phorate	298-02-2	5.00E-01	1.00E-01
Phosphine	7803-51-2	2.00E-01	1.00E-02
Phosphorus, white	7723-14-0	2.00E-01	1.00E-02
Phthalic anhydride	85-44-9	5.00E-01	1.00E-01
Polybrominated biphenyls	67774-32-7	9.30E-01	1.00E-01
Polychlorinated biphenyls	1336-36-3	8.10E-01	1.40E-01
Pronamide	23950-58-5	5.00E-01	1.00E-01
Propargite	2312-35-8	5.00E-01	1.00E-01
Propham	122-42-9	5.00E-01	1.00E-01
Pyrene	129-00-0	8.90E-01	1.30E-01
Quinoline	91-22-5	5.00E-01	1.00E-01
Selenium	7782-49-2	5.00E-01	1.00E-02
Selenourea	630-10-4	---	---
Silver	7440-22-4	4.00E-02	1.00E-02
Sodium diethyldithiocarbamate	148-18-5	---	---
Strychnine	57-24-9	5.00E-01	1.00E-01
TCDD, 2,3,7,8- (dioxin)	1746-01-6	---	---
Tetrachlorobenzene, 1,2,4,5-	95-94-3	5.00E-01	1.00E-01
Tetrachlorophenol, 2,3,4,6-	58-90-2	5.00E-01	1.00E-01
Tetraethyl dithiopyrophosphate	3689-24-5	5.00E-01	1.00E-01
Tetraethyl lead	78-00-2	5.00E-01	1.00E-01
Thallium and compounds (as thallium chloride)	7791-12-0	1.00E+00	1.00E-02
Thiofanox	39196-18-4	5.00E-01	1.00E-01
Thiophanate-methyl	23564-05-8	5.00E-01	1.00E-01
Thiram	137-26-8	5.00E-01	1.00E-01
Tin	7440-31-5	1.00E-01	1.00E-02
Toluenediamine, 2,4-	95-80-7	5.00E-01	1.00E-01
Toluenediamine, 2,6-	823-40-5	5.00E-01	1.00E-01
Toluene diisocyanate, 2,4/2,6-	26471-62-5	5.00E-01	1.00E-01
Toluidine, p-	106-49-0	5.00E-01	1.00E-01
Toxaphene	8001-35-2	5.00E-01	1.00E-01

COC	CAS #	ABS_{GI} (unitless)	ABS.d (unitless)
TP Silvex, 2,4,5-	93-72-1	5.00E-01	1.00E-01
Triallate	2303-17-5	5.00E-01	1.00E-01
Tributyltin oxide	56-35-9	5.00E-01	1.00E-01
Trichlorobenzene, 1,2,4-	120-82-1	9.70E-01	1.00E-01
Trichlorophenol, 2,4,5-	95-95-4	5.00E-01	1.00E-01
Trichlorophenol, 2,4,6-	88-06-2	5.00E-01	1.00E-01
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	5.00E-01	1.00E-01
Trifluralin	1582-09-8	5.00E-01	1.00E-01
Trinitrobenzene, 1,3,5-	99-35-4	6.50E-01	1.00E-01
Trinitrophenylmethylnitramine	479-45-8	5.00E-01	1.00E-01
Trinitrotoluene, 2,4,6-	118-96-7	6.00E-01	1.00E-01
Uranium (soluble salts)	7440-61-1	8.50E-01	1.00E-02
Vanadium	7440-62-2	2.60E-02	1.00E-02
Vernam	1929-77-7	5.00E-01	1.00E-01
Warfarin	81-81-2	5.00E-01	1.00E-01
Zinc	7440-66-6	2.00E-01	1.00E-02
>10-12 C aliphatics (TPH)	NA	5.00E-01	1.00E-01
>12-16 C aliphatics (TPH)	NA	5.00E-01	1.00E-01
>16-21 C aliphatics (TPH)	NA	5.00E-01	1.00E-01
>16-21 C, >21-35 C aliphatics (TPH) (for transformer mineral oil releases only)	NA	5.00E-01	1.00E-01
>10-12 C aromatics (TPH)	NA	5.00E-01	1.00E-01
>12-16 C aromatics (TPH)	NA	5.00E-01	1.00E-01
>16-21 C aromatics (TPH)	NA	8.90E-01	1.30E-01
>21-35 C aromatics (TPH)	NA	8.90E-01	1.30E-01

(d) Soil ingestion RBEL. The soil ingestion RBEL ($^{Soil}RBEL_{Ing}$) is protective concentration of a COC at the POE in soil based upon human ingestion.

(e) Vegetable ingestion RBELs. The vegetable RBELs ($^{AbgVeg}RBEL_{Ing}$ and $^{BgVeg}RBEL_{Ing}$) are the protective concentration of a COC in aboveground vegetables and below-ground vegetables, respectively, for ingestion by residents. The person shall establish RBELs for ingestion of aboveground vegetables for all carcinogenic and noncarcinogenic COCs which are metals. In addition, the person shall establish RBELs for ingestion of below-ground vegetables for all carcinogenic and noncarcinogenic COCs with a dimensionless Henry's Law Constant less than 0.03, as shown in the figure in §350.73(f) of this title (relating to Determination and Use of Human Toxicity Factors and Chemical Properties), when either of

the following criteria are met:

(1) the COC is a metal; or

(2) the COC has a logarithmic octanol-water partition coefficient (Log K_{ow}) greater than four as shown in the figure in §350.73(f) of this title (relating to Determination and Use of Human Toxicity Factors and Chemical Properties); or

(f) Groundwater ingestion RBEL.

(1) The groundwater ingestion RBEL ($^{GW}RBEL_{Ing}$) is the protective concentration of a COC at the POE in groundwater based upon human ingestion of groundwater. However, if available, the person shall use the lower of the two values established under paragraphs (2) and (3) of this subsection instead.

(2) The person shall use the primary MCL as provided in 40 Code of Federal Regulations Part 141, as amended, or the most currently available federal action level for drinking water (e.g., lead and copper) as the RBEL when available for the COC.

(3) The person shall use the secondary MCLs established for individual COCs as provided in 40 Code of Federal Regulations Part 143, as amended, as RBELs, or other scientifically valid published criteria in cases where COCs are present at concentrations which present objectionable characteristics such as taste or odor (e.g., methyl tertiary butyl ether) under the following circumstances:

(A) when the COCs are present in class 1 groundwater;

(B) when the COCs are present in class 2 groundwater that is within 1/2 mile of a well used to supply drinking water and is also within or is likely to migrate, based upon the chemical properties of the COCs and the hydrogeology, to the groundwater production zone of such drinking water supply well; or

(C) when the COCs are present in class 2 groundwater and there are no alternative water supplies available.

(g) Class 3 groundwater RBEL. The class 3 groundwater RBEL ($^{GW}RBEL_{Class\ 3}$) is the acceptable concentration of a COC at the POE in class 3 groundwater.

(h) Surface water RBEL. The surface water RBEL ($^{SW}RBEL$) is the protective concentration of a COC at the POE in surface water. To establish $^{SW}RBEL$ for a COC, the person shall determine the lowest value from paragraphs (1) - (5) of this subsection for each COC, unless the person has sufficient surface water quality information specific to the particular surface water body to support an adjustment to the RBEL in accordance with paragraph (6) of this subsection. The $^{SW}RBEL$ value determined pursuant to paragraphs (1) - (6) of this subsection may require modification in response to the requirements of paragraphs (7) and (8) of this subsection. The $^{SW}RBEL$ value for a given COC shall be protective of relevant downgradient water bodies in consideration of the water body use (e.g., designated drinking

water supply or sustainable fishery), the water body type (e.g., estuary or perennial freshwater stream), the standards applicable to the type of water body/use, and the fate and transport characteristics of the COC in question at the particular affected property.

(1) The person shall apply the lower of the acute or chronic criteria for fresh or marine waters as applicable, based on the classification of the surface water, to protect aquatic life as provided in §307.6, Table 1 of this title (relating to Toxic Materials), as amended. The person shall determine the applicability of aquatic life criteria related to the water body aquatic life use and flow conditions in accordance with the procedures contained in §307.3, §307.4, and §307.6 of this title (relating to Definitions and Abbreviations, General Criteria, and Toxic Materials, respectively), and the agency's *Implementation Procedures*, as amended, as defined in §350.4 of this title (relating to Definitions and Acronyms), as amended. For fresh waters, the person shall calculate aquatic life criteria for metals with hardness-dependent criteria using the hardness value for the nearest downstream classified segment, as listed in the agency's *Implementation Procedures*, as amended. Where no value is provided in the *Implementation Procedures*, a hardness value of 50 mg/l $CaCO_3$ shall be used. When applicable, the person shall convert total metal concentrations in surface water or groundwater to dissolved concentrations as described in the agency's *Implementation Procedures*, as amended. The person may use the basin-specific pH values provided in §307.6, Table 2 of this title, as amended, relevant to the particular affected property for purposes of determining the appropriate values for the pH dependent criteria. The person shall use the total suspended solids concentration for the nearest classified segment, as listed in the agency's *Implementation Procedures*, as amended.

(2) The person shall apply the human health criteria to protect drinking water and fisheries as provided in Table 3 of §307.6 of this title, as amended. When applicable, the person shall convert total metal concentrations in surface water or groundwater to dissolved concentrations as described in the agency's *Implementation Procedures*, as amended. The person shall determine the applicability of human health criteria according to the water body uses (e.g., public water supply, sustainable fishery, incidental fishery, and contact recreation) in accordance with the procedures contained in §307.3 and §307.6 of this title, as amended, and the *Implementation Procedures*, as amended. When a water body is not being evaluated as a drinking water source, the person must determine the necessity to evaluate exposure pathways associated with contact recreation such as incidental ingestion of surface water and dermal contact with surface water. The person shall use the total suspended solids concentration for the nearest classified segment, as listed in the agency's *Implementation Procedures*, as amended.

(3) The person shall apply the effluent limitations specified in Texas Pollutant Discharge Elimination System (TPDES) General Permit Number TXG830000, as amended, for any release of groundwater or storm water that has been impacted by petroleum fuel (as defined in the general permit).

(4) The person shall apply United States EPA guidelines or alternate provisions in accordance with §307.6(c)(7) of this title, as amended, when criteria for aquatic life protection are not provided for a COC in §307.6 of this title, Table 1, as amended. In addition, the person shall apply federal guidance criteria (i.e., lower of a federal numerical criterion, MCL, or equivalent state drinking water guideline) or alternate provisions in accordance with §307.6(d)(8) of this title, as amended, when human health criteria for a COC are not provided in Table 3 of §307.6 of this title, as amended.

(5) The person shall apply the numerical criteria, as appropriate, for chlorides, sulfates, total dissolved solids, and pH for classified segments as specified in §307.10(1) of this title (relating to Appendices A - E), as amended.

(6) The person may apply additional provisions where data on surface water quality for a specific surface water body at the affected property is available or can be reasonably obtained.

(A) The person may determine property-specific hardness, based on sampling data, for calculating metals criteria in accordance with the procedures contained in the agency's *Implementation Procedures*, as amended.

(B) The person may determine property-specific total suspended solids, based on sampling data, for estimating "dissolved" metals in accordance with the *Implementation Procedures*, as amended.

(C) The person may determine the actual pH of the particular surface water body at the affected property.

(7) The additional numeric and narrative criteria listed in subparagraphs (A) and (B) of this paragraph may require development of a surface water RBEL (e.g., where a nutrient is a COC) or modification to the surface water RBEL (e.g., lower a RBEL value to minimize foaming on the water's surface) determined pursuant to paragraphs (1) - (5) of this subsection.

(A) General criteria related to aesthetic parameters, nutrient parameters, and salinity in accordance with §307.4(b), (e), and (g) of this title (relating to General Criteria), as amended.

(B) General provisions related to the preclusion of adverse toxic effects on aquatic and terrestrial life, livestock, or domestic animals in accordance with §307.6(b) of this title, as amended.

(8) If the executive director determines that the release has the potential to lower the surface water dissolved oxygen, then the executive director may require the person to apply the dissolved oxygen criteria for classified segments specified in §307.10(1) of this title, as amended, or the dissolved oxygen criteria for unclassified waters specified in §307.10(4) of this title, as amended, §307.4(h) of this title, as amended, and §307.7(b)(3)(A) of this title (relating to Site Specific Uses and Criteria), as amended.

(i) Aesthetics. For COCs for which a RBEL cannot be calculated by the procedures of this section, or the RBEL concentration for the COC otherwise adversely impacts environmental quality or public welfare and safety, presents objectionable characteristics (e.g., taste, odor), or makes a natural resource unfit for use, the person shall comply with paragraphs (1) - (3) of this subsection as appropriate. For response actions which are triggered for an area solely for purposes of this subsection (i.e., there is no other human health or ecological hazard remaining), the executive director will evaluate the seriousness, probable longevity of the matter, and suitability of the proposed remedy with the landowner in order to site-specifically determine whether or not institutional controls and financial assurance are warranted. The person shall provide all information reasonably necessary to support such a determination to the executive director. The default presumption is that financial assurance and institutional controls are

required for exposure prevention remedies. If the executive director determines that institutional controls and financial assurance are not warranted, then persons shall not be required to comply with the provisions of §350.31(g), §350.33(e)(2)(C) and §350.111(b)(3) or (6) of this title (relating to General Requirements for Remedy Standards, Remedy Standard B, and Use of Institutional Controls), specifically relating to the physical control matters for the portion of affected property with the aesthetics issue.

(1) In accordance with §101.4 of this title (relating to Nuisance), as amended, the person may be required by the executive director to address COCs which present objectionable odors.

(2) The maximum total soil concentration of COCs which are liquid at standard temperature and pressure shall not exceed 10,000 mg/kg within the soil interval of 0 - 10 feet, unless it can be demonstrated that:

(A) no free liquids (e.g., no mobile NAPL) or sludges exist; or

(B) higher concentrations do not adversely impair surface use of the affected property.

(3) Other scientifically valid published criteria such as, but not limited to, non-COC specific secondary MCLs for water may be required by the executive director to be used as the RBEL.

(j) Requirements for variance to default RBEL exposure factors.

(1) Under Tiers 2 or 3 as provided in §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) and with prior executive director approval, the person may vary the following default exposure factors shown in the figures in subsections (a) and (c) of this section based on conditions or exposure levels at a particular affected property and in accordance with the conditions specified. A person shall provide the supporting documentation to justify the use of such alternative factors to the executive director.

(A) Gastrointestinal absorption fraction (ABS_{GI}). A person or the executive director may use an alternative scientifically justifiable gastrointestinal absorption fraction value. Only in cases where the gastrointestinal absorption fraction is less than 50% shall the oral slope factor and oral reference dose be adjusted using equation RBEL-2 as shown in the figure in subsection (a) of this section, as applicable, to calculate the corresponding dermal slope factor and dermal reference dose. The person shall not use the gastrointestinal absorption fraction to modify the oral slope factor or oral reference dose for any exposure pathway other than the dermal exposure pathway. In the event the executive director determines a more scientifically valid gastrointestinal absorption fraction, that fraction shall be presumed to be the appropriate fraction and the person shall use that fraction unless a person rebuts that value with a scientifically valid study or by other credible published authority.

(B) Dermal absorption fraction (ABS.d). A person or the executive director may conduct a scientifically valid study using property-specific soils or may use alternative scientifically justifiable dermal absorption values. In the event the executive director determines a more scientifically valid dermal absorption fraction, that fraction shall be presumed to be the appropriate fraction and the

person shall use that fraction unless a person rebuts that fraction with a scientifically valid study using property-specific soils or by other credible published authority.

(C) Relative bioavailability factor (RBAF). A person or the executive director may conduct a scientifically valid bioavailability study using property-specific soils or may conduct mineralogical evaluations of the chemical form of a COC present in soils at the affected property. In the event the executive director determines a more scientifically valid relative bioavailability factor, that factor shall be presumed to be the appropriate relative bioavailability factor and the person shall use that factor unless a person rebuts that factor with a scientifically valid bioavailability study using property-specific soils, mineralogical evaluation of the chemical form of a chemical of concern present in soils at the affected property, or by other credible published authority.

(2) Under Tiers 2 or 3 as provided in §350.75 of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), a person may request that the executive director allow a variance to the following default commercial/industrial exposure factors for the affected property as shown in the figure in subsection (a) of this section: averaging time for noncarcinogens (AT.w), exposure duration (ED.w), and exposure frequency (EF.w). This shall only be allowed for facilities that have or will have, as a condition of the approval of this variance, restricted property access. The executive director shall not delegate this decision to agency staff.

(A) The person shall submit information to the executive director which demonstrates that variance from the default exposure factors is supported by property-specific information; historical, current, and probable future land use; redevelopment potential; and compatibility with surrounding land use. The person shall also provide written concurrence from the landowner for the placement of the institutional control in the county deed records, as required in subparagraph (L) of this paragraph, unless the property is subject to zoning or governmental ordinance which is equivalent to the deed notice, VCP certificate of completion or restrictive covenant that otherwise would have been required.

(B) The person requesting such variance shall provide public notification as described in subparagraphs (D) and (E) of this paragraph for any request to vary the default exposure factors at the same time that variance-based PCLs are submitted to the executive director for approval. If the natural physical condition of the on-site commercial/industrial area for which the variance is sought essentially prohibits full commercial/industrial use (e.g., marshes and cliffs), and the variance would not necessitate a lesser commercial/industrial use of that area, then the executive director will determine the need for public notice on a site-specific basis for the prohibited use area. The person may request the executive director or his staff to review the variance-based PCLs or the variance request for completeness (e.g., administratively complete, mathematical accuracy, compliance with other PCL development procedures) in advance of initiating the public notification process. The required public notice shall be completed prior to consideration of the variance request for approval by the executive director. The public notice provisions may be performed in conjunction with or as part of another public participation/notification process required for permitting or other applicable state or federal statute or regulation provided the requirements of subparagraph (E) of this paragraph are also met. Additionally, an alternative mechanism that may exist under the other public participation/notification process which effectively provides broad public notice of the variance request, such as notification to an existing citizens' advisory board for the affected property/facility, may substitute for the requirements of

subparagraph (D) of this paragraph, provided the completion of the notification is sufficiently documented.

(C) The notice shall contain, at a minimum, the following information:

(i) the name, address and telephone number of the person requesting the variance;

(ii) the address and the physical description for the location of the property and the agency case designation number;

(iii) the modified value(s) the person seeks to use and the associated default exposure factor(s) as shown in the figure in subsection (a) of this section without any statements or other indications that such variance has been approved or otherwise considered favorably by the executive director or the executive director's staff other than that it has been reviewed for completeness;

(iv) a clear and concise explanation as to the effect the variance will have on the future use of the subject property and on surrounding properties;

(v) a statement that more detailed information regarding the variance request is available for review at the agency's central office in Austin, Texas, 8:00 am - 5:00 pm Monday thru Friday; and

(vi) a notice to the public of the opportunity to submit written information, within 30 calendar days after the date of the initial published notice (publish the actual date), to the executive director which demonstrates that the proposal for variance from the default exposure factors would be compatible or incompatible with existing neighboring land uses and preservation of the active and productive land use of the subject property.

(D) The notice shall be published in a newspaper distributed daily, if available, and generally circulated in the county or area where the property is located. The notice shall be published once a week for three weeks, with at least one of the notices appearing in a Sunday edition, if available.

(E) The notice shall be sent to the following persons in clauses (i) - (viii) of this subparagraph by certified mail, return receipt requested:

(i) all adjacent landowners;

(ii) the local municipality planning board or similar governmental unit, if applicable;

(iii) local taxing authorities;

(iv) the mayor and health authorities of the city in which the property is located, if applicable;

(v) the county judge and county health authority of the county in which the property is located;

(vi) the agency's Public Interest Counsel;

(vii) all persons or organizations who have requested the notice or expressed interest; and

(viii) other persons or organizations specified by the executive director.

(F) The person shall provide copies of each notice sent by mail, copies of the published notice, and copies of the signed publisher's affidavit for the initial notice to the agency's Austin office and to the appropriate agency region office within 10 calendar days after the initial publication and mailing. Copies of the signed publisher's affidavits for the subsequent notices shall be provided to the agency's Austin office and to the appropriate agency region office within 10 days of both subsequent notices.

(G) At the executive director's request, and at the expense of the person, the person shall schedule and hold a public meeting at a time and place which are convenient for persons identified in subparagraph (E) of this paragraph. The forum chosen for the meeting shall comply with the Americans with Disabilities Act. Prior to scheduling the public meeting, the person shall coordinate the scheduling of the public meeting with the executive director's office to ensure the availability of agency personnel for the meeting. The person shall confirm with the executive director's office the date, time, and location of the meeting not less than 15 days prior to the meeting. The meeting shall be open to the public to provide information on the request to vary the default exposure factors and to allow for comments by the public. The person shall again confirm with the executive director's office on the time and place of the meeting at least 72 hours prior to the meeting.

(H) In order to inform persons of the public meeting, the person shall, at least 30 calendar days prior to the public meeting, follow the notification process required in subparagraphs (C) - (F) of this paragraph with the following exceptions:

(i) the notice shall be supplemented to include the date, time, and location of the public meeting and to indicate that the meeting is open to the public for the purposes of providing information on the request to vary default exposure factors and to provide the public the opportunity to provide comments on the request;

(ii) the notice shall indicate that the public shall have 15 calendar days after the date of the public meeting to submit written information to the executive director which demonstrates that the proposal for variance from the default exposure factors would be compatible or incompatible with existing neighboring land uses and preservation of the active and productive land use of the subject property; and

(iii) the notice by publication of the public meeting shall only be published once and shall be placed in a Sunday edition, if available.

(I) The executive director's decision on the request for a variance from the default exposure factors shall occur at least 15 calendar days after any public meeting or if no public meeting is held, at least 45 days after the date of the initial published notice. The executive director's decision shall be based upon property-specific data; historical, current, and probable future land use; redevelopment potential; and compatibility with surrounding land use. The executive director shall not consider the costs incurred for any actions taken by the person in anticipation that the variance would be approved by the executive director.

(J) At the same time that the executive director's decision is mailed to the person requesting the variance, a copy of this decision shall also be mailed to all persons identified in subparagraph (E) of this paragraph. The notice of the executive director's decision shall explain the method for submitting a motion for reconsideration of the executive director's decision by the commission.

(K) The person requesting the variance and persons identified in subparagraph (E) of this paragraph may file with the chief clerk a motion for reconsideration of the executive director's decision related to the request for variance, in accordance with §50.39(b) - (f) of this title (relating to Motion for Reconsideration), as amended.

(L) A person who receives a variance from the default exposure factors shall comply with the institutional control requirements in §350.111(b), (b)(12), or (13) of this title (relating to Use of Institutional Controls), as applicable, and provide proof of compliance with the institutional control requirements within 90 days of the approval by the executive director of the RACR.

(3) The person shall not vary the following exposure factors shown in the figure in subsection (a) of this section.

(A) averaging time for residents for noncarcinogens (AT.A.res and AT.C.res) or carcinogens (ATc);

(B) body weight for adults and children (BW.A, BW.C, $BW_{(0<6)}$, $BW_{(6<18)}$, and $BW_{(18<30)}$);

(C) exposure duration for residents (ED.A.res, ED.C.res, $ED_{(0<6)}$, $ED_{(6<18)}$, and $ED_{(18<30)}$);

(D) exposure frequency for residents (EF.res);

(E) ingestion rate for soil, water, or vegetables (IRsoil.AgeAdj.res, IRsoil.C.res, IRsoil.w, IRw.AgeAdj.res, IRw.C.res, IRw.w, IRabg.AgeAdj.res, IRbg.AgeAdj.res, IRabg.C.res, IRbg.C.res);

(F) toxicity modifying factor (MF);

(G) skin surface area (SA.C.res, $SA_{(0<6)}$, $SA_{(6<18)}$, $SA_{(18<30)}$, SA.w);

(H) soil-to-skin adherence factors (AF.C.res, $AF_{(0<6)}$, $AF_{(6<18)}$, $AF_{(18<30)}$, and AF.w).

Adopted February 21, 2007 Effective March 19, 2007

§350.75. Tiered Human Health Protective Concentration Level Evaluation.

(a) General.

(1) The person shall decide whether to use Tier 1, 2, and/or 3 to determine the PCLs for an affected property, except as provided in paragraph (2) of this subsection and unless required by subsection (b), (c), or (d) of this section.

(2) The executive director may require the person to establish PCLs in accordance with Tier 1, 2, and/or 3 for state-funded response actions at affected properties.

(b) Tier 1 PCLs.

(1) Tier 1 is a risk-based analysis to derive non-site-specific PCLs for complete or reasonably anticipated to be completed exposure pathways. Tier 1 is based on default exposure factors and affected property parameters in the applicable PCL equations provided in the following figure and assumes exposure occurs at, above or below the source area (i.e., no lateral transport).

Tier 1 PCL Equations

Groundwater Ingestion PCL Equation: $^{GW}GW_{Ing}$

Exposure Pathway Description: Ingestion of groundwater
Source Medium: Groundwater
Exposure Medium: Groundwater

$^{GW}GW_{Ing} = {}^{GW}RBEL_{Ing}$ *(See Eq. RBEL-4, Figure: 30 TAC §350.74(a))*

Class 3 Groundwater PCL Equation: $^{GW}GW_{Class\ 3}$

Exposure Pathway Description: Class 3 groundwater
Source Medium: Class 3 groundwater
Exposure Medium: Class 3 groundwater

$^{GW}GW_{Class\ 3} = {}^{GW}RBEL_{Class\ 3}$ *(See Eq.RBEL-5, Figure: 30 TAC §350.74(a))*

Groundwater Volatilization PCL Equation: $^{Air}GW_{Inh\text{-}V}$

Exposure Pathway Description: Inhalation of volatiles from class 1, 2, or 3 groundwater
Source Medium: Class 1, 2, or 3 groundwater
Exposure Medium: Outdoor air

$$^{Air}GW_{Inh\text{-}V} = \frac{^{Air}RBEL_{Inh}}{VF_{Wamb}}$$ *(See Eq. RBEL-1, Figure: 30 TAC §350.74(a))*

$$VF_{wamb}\left[\frac{mg/m^3 - air}{mg/L - H_2O}\right] = \frac{H'}{1+\left[\frac{U_{air}\delta_{air}L_{gw}}{W_g D_{ws}^{eff}}\right]} \bullet \left[10^3 \frac{L}{m^3}\right]$$

$$D_{ws}^{eff}\left[\frac{cm^2}{s}\right] = (h_{cap} + h_v)\left[\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}}\right]^{-1}$$

$$D_{cap}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{acap}^{3.33}}{\theta_T^2} + \left[\frac{D^{wat}}{H'}\right]\left[\frac{\theta_{wcap}^{3.33}}{\theta_T^2}\right]$$

$$D_s^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + \left[\frac{D^{wat}}{H'}\right]\left[\frac{\theta_{ws}^{3.33}}{\theta_T^2}\right]$$

Groundwater-to-Surface Water PCL Equation: ^{SW}GW

Exposure Pathway Description: Discharge of class 1, 2, or 3 groundwater to surface water
Source Medium: Class 1, 2, or 3 groundwater
Exposure Medium: Surface water

$$^{SW}GW = \frac{^{SW}SW}{DF}$$

(See Eq. RBEL-6, Figures: 30 TAC §350.74(a); and 30 TAC §350.75(i)(4))

Term	*COC Chemical/Physical and Affected Property Parameters Definition*	*Tier 1 Defaults*	*Change to Tier 1 Default Allowed?*	*Rule Citation Regarding Change*
ρ_b	Soil bulk density (g/cm^3)	1.67	Tier 2, 3	§350.75(c) and (d)
θ_{ws}	Volumetric water content of vadose zone soils (cm^3-water/cm^3-soil)	0.16	Tier 2, 3	§350.75(c) and (d)
θ_{as}	Volumetric air content of vadose zone soils (cm^3-air/cm^3-soil) = θ_T-θ_{ws}	0.21	Tier 2, 3	§350.75(c) and (d)
θ_T	Total soil porosity = 1 - (ρ_b/ρ_s) (cm^3-pore space/cm^3-soil)	0.37	Tier 2, 3	§350.75(c) and (d)
ρ_s	Particle density (g/cm^3)	2.65	Tier 2, 3	§350.75(c) and (d)
H′	Dimensionless Henry's Law Constant	(Figure: 30 TAC §350.73(f))	No	NA
H	Henry's Law Constant (atm-m^3/mole) (H=H′RT)	(Figure: 30 TAC §350.73(f))	No	NA
R	Universal Gas Constant (atm m^3 mol^{-1} °K^{-1})	8.206 x 10^{-5}	No	NA
T	Temperature (°K) = 273 + °C	293	No	NA
U_{air}	Windspeed above ground surface in ambient mixing zone (cm/s)	240	Tier 2, 3	§350.75(c) and (d)
δ_{air}	Ambient air mixing zone height (cm)	200	No	NA
L_{gw}	Depth to groundwater = h_{cap} + h_v (cm)	305	Tier 2, 3	§350.75(c) and (d)

Term	*COC Chemical/Physical and Affected Property Parameters Definition*	*Tier 1 Defaults*	*Change to Tier 1 Default Allowed?*	*Rule Citation Regarding Change*
D^{eff}_{ws}	Effective diffusivity above water table (cm^2/s)	COC and affected property specific	Tier 2, 3	§350.73(f) and §350.75(c) and (d)
D^{eff}_{cap}	Effective diffusivity in the capillary fringe (cm^2/s)	COC and affected property specific	Tier 2, 3	§350.73(f) and §350.75(c) and (d)
D^{eff}_{s}	Effective diffusivity in vadose zone soils (cm^2/s)	COC and affected property specific	Tier 2,3	§350.73(f) and §350.75(c) and (d)
h_{cap}	Thickness of capillary fringe (cm)	5	Tier 2, 3	§350.75(c) and (d)
h_v	Thickness of vadose zone (cm)	300	Tier 2, 3	§350.75(c) and (d)
W_g	Width of groundwater source in the direction to the closest off-site property line from the groundwater source (cm)			§350.75(c) and (d)
	• 0.5 acre source	4,500	Tier 2, 3	
	• 30 acre source	34,800	Tier 2, 3	
θ_{acap}	Volumetric air content of capillary fringe soils (cm^3-air/cm^3-soil)	0.037	Tier 2, 3	§350.75(c) and (d)
θ_{wcap}	Volumetric water content of capillary fringe soils (cm^3-water/cm^3-soil)	0.333	Tier 2, 3	§350.75(c) and (d)
D^{air}	Diffusion coefficient in air (cm^2/s)	(Figure: 30 TAC §350.73(f))	No	NA
D^{wat}	Diffusion coefficient in water (cm^2/s)	(Figure: 30 TAC §350.73(f))	No	NA
DF	Surface Water Dilution Factor	NA	Tier 2, 3	§350.75(i)(4)

Soil PCL Equation: $^{Tot}Soil_{Comb}$

Exposure Pathway Description: Combined equation for ingestion of surface soil + dermal contact with surface soil + inhalation of surface soil volatiles and particulates + consumption of garden vegetables grown in contaminated surface soil
Source Medium: Surface soils
Exposure Medium: Surface soil and air (and vegetables for residential land use only).

Residential

$$^{Tot}Soil_{Comb} = \frac{1}{[\frac{1}{^{Air}Soil_{Inh-VP}}]+[\frac{1}{^{Soil}Soil_{Derm}}]+[\frac{1}{^{Soil}Soil_{Ing}}]+\left[\left(\frac{1}{^{Veg}Soil_{Ing-Inorg}}\right) or \left(\frac{1}{^{Veg}Soil_{Ing-Org}}\right)\right]}$$

Commercial/Industrial Worker

$$^{Tot}Soil_{Comb} = \frac{1}{\left(\frac{1}{^{Air}Soil_{Inh-VP}}\right)+\left(\frac{1}{^{Soil}Soil_{Derm}}\right)+\left(\frac{1}{^{Soil}Soil_{Ing}}\right)}$$

Soil PCL Equation: $^{Air}Soil_{Inh\text{-}VP}$

Exposure Pathway Description: Inhalation of surface soil volatiles and particulates
Source Medium: Surface soils
Exposure Medium: Air

$$^{Air}Soil_{Inh-VP} = \frac{^{Air}RBEL_{Inh}}{VF_{ss}+PEF}$$ *(See Eq. RBEL-1, Figure: 30 TAC §350.74(a))*

Soil PCL Equation: $^{Soil}Soil_{Derm}$

Exposure Pathway Description: Dermal contact with surface soil
Source Medium: Surface soil
Exposure Medium: Surface soil

$^{Soil}Soil_{Derm} = {}^{Soil}RBEL_{Derm}$ *(See Eq. RBEL-2, Figure: 30 TAC §350.74(a))*

Exposure Pathway Description: Ingestion of surface soil
Source Medium: Surface soil
Exposure Medium: Surface soil

$^{Soil}Soil_{Ing} = {}^{Soil}RBEL_{Ing}$ *(See Eq. RBEL – 3, Figure: 30 TAC §350.74(a))*

Soil PCL Equation: $^{Veg}Soil_{Ing\text{-}Inorg}$, & $^{Veg}Soil_{Ing\text{-}Org}$
(for residential land use only).

Exposure Pathway Description: Consumption of garden vegetables grown in contaminated surface soil
Source Medium: Surface soil
Exposure Medium: Vegetables

$$^{Veg}Soil_{Ing-Inorg} = \frac{1}{\frac{Br_{abg}}{AbgVeg\,RBEL_{Ing}} + \frac{Br_{bg}}{bgVeg\,RBEL_{Ing}}}$$ *(See Eq. RBEL – 7, Figure: 30 TAC §350.74(a))*

$$^{Veg}Soil_{Ing-Org} = \frac{\left(^{BgVeg}RBEL_{Ing}\right)\left(Ks_{Veg}\right)}{\left(RCF\right)\left(VG_{bg}\right)}$$ *(See Eq. RBEL – 7, Figure: 30 TAC §350.74(a))*

Soil PCL Equation: $^{Air}Soil_{Inh\text{-}V}$

Exposure Pathway Description: Inhalation of subsurface soil volatiles
Source Medium: Subsurface soils
Exposure Medium: Air

$$^{Air}Soil_{Inh-V} = \frac{^{Air}RBEL_{Inh}}{VF_{ss}}$$ *(See Eq. RBEL – 1, Figure: 30 TAC §350.74(a))*

Volatilization Factor: VF_{ss}

Where VF_{ss} is the smaller of the two following VF_{ss} values

$$VF_{ss}\left[\frac{mg/m^3 - air}{mg/kg - Soil}\right] = \frac{2\rho_b D_A}{(Q/C)\left[3.14 D_A{}^{\tau}\right]^{\frac{1}{2}}} \cdot \left(\frac{10^4 cm^2}{m^2}\right)$$

$$D_A = \left[\frac{\theta_{as}^{3.33} D^{air} H' + \theta_{ws}^{3.33} D^{wat}}{\left[\theta_{ws} + K_d \rho_b + \theta_{as} H'\right]\theta_T^2}\right]$$

or

$$VF_{ss}\left[\frac{mg/m^3 - air}{mg/kg - soil}\right] = \frac{\rho_b d_s}{(Q/C)\tau} \cdot \left(\frac{10^4 cm^2}{m^2}\right)$$

Particulate Emission Factor: PEF

$$PEF\left[\frac{mg/m^3-air}{mg/kg-soil}\right]=\frac{(0.036)(1-V)\left(\frac{U_m}{U_1}\right)^3 F(x)}{(Q/C)(3600s/hr)}$$

Soil-to-Groundwater PCL Equation: ^{GW}Soil

Exposure Pathway Description: Soil leachate to groundwater
Source Medium: Surface and subsurface soils
Exposure Medium: Groundwater

$$^{GW}Soil=\frac{(GroundwaterPCL^*)\cdot LDF}{K_{sw}}$$

$$K_{sw}\left[\frac{(mg/L-H_2O)}{(mg/kg-soil)}\right]=\frac{\rho_b}{\theta_{ws}+K_d\rho_b+H'\theta_{as}}$$

*Critical groundwater PCL as determined in accordance with §350.78 of this title (relating to Determination of Critical PCLs) or attenuation action level as determined in accordance with §350.33(f)(4)(D) of this title (relating to Remedy Standard B).

Theoretical Residual Soil Saturation Limit PCL ($Soil_{Res}$)

$$\mathrm{Soil_{Res}(mg/kg)}=\left(\frac{\mathrm{Res.sat}\times\theta_\tau\times\mathrm{p}}{\rho_\mathrm{b}}\right)\ \text{x 1,000,000 mg/kg}$$

Term	*COC Chemical/Physical and Affected Property Parameters Definition*	*Tier 1 Defaults*	*Change to Tier 1 Default Allowed?*	*Rule Citation Regarding Change*
Br_{Abg}	Soil-to-above ground plant biotransfer factor (g soil/g dry weight plant tissue)	(Figure: 30 TAC §350.73(f))	Tier 2, 3	§350.73(f)(2)
Br_{Bg}	Soil-to-below ground plant biotransfer factor (g soil/g dry weight plant tissue)	(Figure: 30 TAC §350.73(f))	Tier 2, 3	§350.73(f)(2)
RCF	Ratio of concentration in roots to concentration in soil pore water (mg/kg) (µg/ml)	$\frac{(10^{((0.77 \times \log K_{ow})-1.52)}+ 0.82)}{0.222}$	Special Consideration	§350.73(f)
log K_{ow}	Octanol-water partition coefficient	(Figure: 30 TAC §350.73(f))	Special Consideration	§350.73(f)
Ks_{Veg}	Soil-water partition coefficient (mL/g) = K_{oc} x f_{oc}	chemical specific	Tier 2, 3	§350.73(f) and §350.75(c) and (d)
VG_{bg}	Below ground vegetable correction factor (unitless)	0.01	No	NA
D_A	Apparent diffusivity (cm^2/sec)	chemical specific	Tier 2, 3	§350.73(f) and §350.75(c) and (d)
ρ_b	Soil bulk density (g/cm^3)	1.67	Tier 2, 3	§350.75(c) and (d)
Q/C	Inverse of mean concentration in air at center of affected soil area ([g/m^2-s]/[kg/m^3])			§350.75(c) and (d)
	Default location assumed:	Houston	Tier 2, 3	
	• 0.5 acre source	79.25	Tier 2, 3	
	• 30 acre source	40.76	Tier 2, 3	
	Tier 2, 3 may estimate Q/C from the following equation for Houston: Q/C=-9.3087 ln (x) + 69.989, (where x = source area acreage), or other equation representative of Q/C for other city more representative of the affected property conditions and acceptable to the executive director (see USEPA Soil Screening Level Guidance: Technical Background Document, May 1996, EPA/540/R-95/128)			
τ	Exposure interval (s)	9.5×10^8	Tier 2, 3	§350.74(j)(2)
θ_{ws}	Volumetric water content of vadose zone soils (cm^3-water/cm^3-soil)	0.16	Tier 2, 3	§350.75(c) and (d)

Term	*COC Chemical/Physical and Affected Property Parameters Definition*	*Tier 1 Defaults*	*Change to Tier 1 Default Allowed?*	*Rule Citation Regarding Change*
θ_{as}	Volumetric air content of vadose zone soils (cm^3-air/cm^3-soil) =θ_T-θ_{ws}	0.21	Tier 2, 3	§350.75(c) and (d)
D^{air}	Diffusion coefficient in air (cm^2/s)	(Figure: 30 TAC §350.73(f))	No	NA
D^{wat}	Diffusion coefficient in water (cm^2/s)	(Figure: 30 TAC §350.73(f))	No	NA
H′	Dimensionless Henry's Law Constant	(Figure: 30 TAC §350.73(f))	No	NA
H	Henry's Law Constant (atm-m^3/mole) (H=H′RT)	(Figure: 30 TAC §350.73(f))	No	NA
K_d	Soil-water partition coefficient (cm^3-water/g-soil) • for organics • for inorganic	(Figure: 30 TAC §350.73(f)) $k_d = K_{oc}\ f_{oc}$ k_d = pH dependent value	Tier 2, 3	§350.73(f)and (Figures: 30 TAC §350.73(f)(1)(A), (B), (C))
K_{oc}	Soil organic carbon-water partition coefficient (cm^3-water/g-carbon)	(Figure: 30 TAC §350.73(f))	Tier 2, 3	§350.73(f)and (Figure: 30 TAC §350.73(f)(1)(B))
f_{oc}	Fraction of organic carbon in soil (g-carbon/g-soil) • VF_{ss} • Ks_{veg} • K_{sw}	 0.008 0.008 0.002	 Tier 2, 3 Tier 2, 3	 §350.75(c) and (d) §350.75(c) and (d)
θ_T	Total soil porosity = 1 - (ρ_b/ρ_s) (cm^3-pore space/cm^3-soil)	0.37	Tier 2, 3	§350.75(c) and (d)
ρ_s	Particle density (g/cm^3)	2.65	Tier 2, 3	§350.75(c) and (d)
d_s	Thickness of affected surficial soil (cm)	305	Tier 2, 3	§350.75(c) and (d)
V	Fraction vegetative cover (unitless)	0.5	Tier 2, 3	§350.75(c) and (d)
U_m	Mean annual windspeed at 7 m height (m/s)	4.8	Tier 2, 3	§350.75(c) and (d)
U_t	Equivalent threshold value of windspeed at 7 m height (m/s)	11.32	Tier 2, 3	§350.75(c) and (d)

Term	*COC Chemical/Physical and Affected Property Parameters Definition*	*Tier 1 Defaults*	*Change to Tier 1 Default Allowed?*	*Rule Citation Regarding Change*
F(x)	Function dependent on (U_t/U_m) derived using Cowherd et. al. (1985) (unitless)	0.224	Tier 2, 3	§350.75(c) and (d)
R	Universal Gas Constant (atm m^3 mol^{-1} $^oK^{-1}$)	8.206 x 10^{-5}	No	NA
T	Temperature (^oK) = 273 + □C	293	No	NA
K_{sw}	Soil-leachate partition factor for COC (mg/L-water/mg/kg-soil)	property-specific	Tier 2, 3	§350.73(f)and §350.75(c) and (d)
LDF	Leachate Dilution Factor 0.5 acre source area 30 acre source area	 20 10	 Tier 2, 3 Tier 2, 3	 §350.75(c) and (d) §350.75(c) and (d)
Res.sat	The residual saturation limit where the NAPL becomes mobile (cm^3/cm^3) Res.sat = $\frac{10{,}000 \text{ mg/kg} \times \rho_b}{1{,}000{,}000 \text{ mg/kg} \times p \times \theta_T}$	0.04514	Tier 2, 3	§350.75(c) and (d)
p	The density of the NAPL (g/cm^3)	1	Tier 2, 3	§350.75(c) and (d)

Air Source Medium Exposure Pathway PCL Equation
PCL Eq.: $^{Air}Air_{Inh}$ Exposure Pathway Description: Inhalation of air Source Medium: Air Exposure Medium: Air $$^{Air}Air_{Inh} = {}^{Air}RBEL_{Inh}$$ *(See Eq. RBEL-1, Figure: 30 TAC §350.74(a))*

Surface Water Exposure Pathway PCL Equation
PCL Eq.: ^{SW}SW Exposure Pathway Description: Aquatic life and human health protection ($^{SW}RBEL$) and ecological protection ($^{SW}SW_{Eco}$) Source Medium: Surface water Exposure Medium: Surface water ^{SW}SW = *the lesser of* $^{SW}RBEL$ *and* $^{SW}SW_{ECO}$ (see RBEL-6, Figure 30 TAC §350.74(a), §350.74(h), and §350.77(a))

(2) No lateral transport equations may be used for a Tier 1 evaluation other than to ensure that receptors at off-site POEs are protected when on-site commercial/industrial land use is assumed. The person shall assume a 0.5 acre source area for an affected property with a 0.5 acre or less source area and a 30 acre source area for an affected property with a source area in excess of 0.5 acres. The size of the source area in soil and groundwater shall be determined using the soil or groundwater assessment level calculated for a 0.5 acre source area. The executive director may require that the source area include all areas of the affected property which exceed the assessment level and not just contiguous areas when such assumption is appropriate considering the distribution of the COCs.

(3) The person shall establish PCLs using parameters which are specific to the affected property when use of the Tier 1 default affected property parameters would not be protective or when requested by the executive director. The person shall then establish PCLs in accordance with subsections (c) or (d) of this section.

(4) The person shall establish PCLs in accordance with subsections (c) or (d) of this section for any groundwater, soil, surface water, air, or sediment human health exposure pathway which is complete or reasonably anticipated to be completed at an affected property and for which an equation is not referenced in this subsection.

(c) Tier 2 PCLs.

(1) Tier 2 is a risk-based analysis to derive site-specific PCLs for complete or reasonably anticipated to be completed exposure pathways utilizing site-specific exposure factors, as allowable, and/or affected property parameters and Tier 1 equations. Tier 2 PCLs may also include lateral transport considerations.

(2) The person shall use:

(A) the relevant RBELs appropriate for the type of COC, exposure pathway, receptor, and land use provided in §350.74 of this title (relating to Development of Risk-Based Exposure Limits);

(B) PCL equations provided by the executive director in guidance, in addition to the PCL equations as shown in the figure in subsection (b)(1) of this section;

(C) the Tier 1 default affected property parameters or appropriately collected and representative site-specific affected property parameters in the PCL equations, unless an entry of "No" in the column titled "Change To Tier 1 Default Allowed?" in the figure as shown in subsection (b)(1) of this section indicates that a particular Tier 1 affected property parameter value shall not be modified under a Tier 2 evaluation; and

(D) PCLs established in accordance with subsection (d) of this section for any groundwater, soil, surface water, air, or sediment exposure pathway which is complete or reasonably anticipated to be completed at an affected property and for which an equation is not referenced either in this subsection or in subsection (b)(1) of this section.

(d) Tier 3 PCLs.

(1) Tier 3 is a risk-based analysis to derive site-specific PCLs for complete or reasonably anticipated to be completed exposure pathways. Tier 3 PCLs are based on measured natural attenuation factors and/or natural attenuation factor models/equations other than those provided for Tier 1 or 2; and may also include site-specific exposure factors, as allowable, and/or affected property parameters.

(2) The person shall use:

(A) field measured natural attenuation factors and/or appropriate natural attenuation factor equations/models other than the Tier 1 and 2 PCL equations;

(B) appropriate equations/models for any remaining surface water, air, or sediment human exposure pathway which is complete or reasonably anticipated to be completed at an affected property and for which an equation is not referenced in subsection (b) or (c) of this section; and

(C) the Tier 1 default affected property parameters or appropriately collected and representative site-specific affected property parameters in the PCL equations, unless an entry of "No" in the column titled "Change To Tier 1 Default Allowed?" in the figure as shown in subsection (b)(1) of this section indicates that a particular Tier 1 affected property parameter value shall not be modified under a Tier 3 evaluation.

(e) Natural attenuation factor documentation. The person must document the use of all natural attenuation factor equations/models other than the natural attenuation factor equations/models provided in this subchapter or agency guidance, such that the derivation of the model and its site-specific application can be understood, and the results of the model reproduced by the executive director. The executive director may require the person to obtain prior approval for the use of alternative natural attenuation factor equations/models in a Tier 3 evaluation.

(f) Decay factors. When the person uses decay factors in any cross-media or lateral transport natural attenuation factor equation in either Tier 2 or 3, the person shall use sufficient monitoring data (i.e., vapor, soils and groundwater samples for COCs or other degradation indicators) to verify the COC is degrading.

(g) Verification. When natural attenuation factor modeling outputs are inconsistent with monitoring data for environmental media at an affected property, the person and the executive director shall generally place more weight on the monitoring data. The executive director may require the person to provide sufficient monitoring data to verify that PCLs established under any tier are based on an appropriate understanding of conditions at the affected property.

(h) Data adequacy. The person shall collect any additional data necessary to support the development of PCLs under any of the tiers.

(i) Pathway specific PCL Considerations.

(1) PCLs for ingestion of COCs in class 1 or 2 groundwater ($^{GW}GW_{Ing}$). The person shall establish this PCL using the applicable equation shown in the figure in subsection (b)(1) of this section.

(2) PCLs for COCs in class 3 groundwater ($^{GW}GW_{Class\ 3}$). The person shall establish this PCL using the applicable equation in the figure in subsection (b)(1) of this section.

(3) PCLs for inhalation of volatile emissions in outdoor air from COCs in groundwater-bearing units ($^{Air}GW_{Inh\text{-}V}$). The person shall establish this PCL using the applicable equations as shown in the figure in subsection (b)(1) of this section for Tier 1.

(4) PCLs for COCs in groundwater discharge to surface water (^{SW}GW). The person shall set ^{SW}GW equal to ^{SW}SW divided by the surface water dilution factor. The ^{SW}SW is the lesser of the $^{SW}RBEL$ established in accordance with §350.74(h) of this title and the SW_{Eco} established in accordance with §350.77 of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels). The surface water dilution factor shall be determined in accordance with subparagraph (A) or (B) of this paragraph. The person shall use the PCL equation as shown in the figure in subsection (b)(1) of this section to establish ^{SW}GW. In the case that different surface water dilution factors may be applicable to the $^{SW}RBEL$ and the SW_{Eco}, the person shall first divide the $^{SW}RBEL$ and the SW_{Eco} by their respective surface water dilution factors and set ^{SW}GW equal to the lowest resulting quotient.

(A) The person shall assume a surface water dilution factor of one when the concentration of all COCs in groundwater at the zone of discharge to surface water is less than or equal to the ^{SW}SW for those COCs at the time the affected property assessment required in §350.51 of this title (relating to Affected Property Assessment) is conducted. The person shall also assume a surface water dilution factor of one for those specific COCs which are listed as impairing the nearest classified segment at or downstream of the affected property. Impaired water bodies are provided in the current Clean Water Act, §303(d) list, as amended.

(B) When the concentration of a COC in groundwater at the zone of discharge to surface water exceeds the ^{SW}SW for that COC at the time the affected property assessment required in §350.51 of this title is conducted, the person may establish a surface water dilution factor in accordance with subparagraph (C), (D), or (E) of this paragraph.

(C) The person may use a surface water dilution factor of 0.15 for non-flowing surface waters such as lakes, estuaries, tidal rivers; and fresh water streams and rivers (where the groundwater discharge is clearly less than 15% of the 7Q2 stream flow as defined in §307.3(a)(34) of this title (relating to Definitions and Abbreviations)), as amended. The person shall use the 7Q2 flows as listed in §307.10(2) of this title (relating to Appendices A - E), as amended, for groundwater discharges directly to a classified segment as listed in §307.10(3) of this title, as amended. For groundwater discharges which are not directly to a classified segment, site-specific 7Q2 values must be determined for the water body directly receiving the groundwater discharge.

(D) For freshwater streams and rivers where the groundwater discharge is clearly greater than 15% of the 7Q2 flow, the person shall estimate property-specific surface water dilution factors based on 7Q2 flows for chronic aquatic-life criteria, 25% of 7Q2 flows for acute aquatic-life criteria, and harmonic mean flows as defined in §307.3(a)(19) of this title, as amended, for human health criteria in accordance with the procedures contained in the *Implementation Procedures*, as amended. The person shall divide the ^{SW}SW by the estimated property-specific dilution factor. The person shall use the 7Q2 flows listed in §307.10(2) of this title, as amended, for groundwater discharges directly to a classified segment as listed in §307.10(3) of this title, as amended. For groundwater discharges which are not directly to a classified segment, site-specific 7Q2 values must be determined for the water body directly receiving the groundwater discharge.

(E) As an alternative to using the dilution factor of 0.15 as specified in subparagraph (C) of this paragraph, the person may measure and/or estimate the groundwater dilution in surface water from appropriate models of groundwater plume dispersion, tracer studies, receiving water and sediment sample analyses, analytical calculations, or other techniques upon the executive director's approval using site-specific base flow conditions for groundwater, 7Q2 conditions for receiving streams, and critical mixing conditions for lakes, estuaries, and tidal streams. The executive director may require a receiving water study to ensure that benthic communities in the sediment are not adversely impacted. In cases where groundwater COCs include bioaccumulative COCs, the executive director may require a receiving water study or empirical analysis to ensure that the release of that particular COC is not causing, or will not result in harmful levels in the tissue of aquatic and terrestrial organisms that feed in the water body.

(F) The person may be required by the executive director to take appropriate action to ensure that discharging groundwater plumes do not result in exceedances of surface water quality standards in significant areas of the potentially affected surface water body.

(5) PCLs for other complete or reasonably anticipated to be completed groundwater exposure pathways. The person shall establish PCLs for exposure pathways other than those listed in paragraphs (1) - (4) of this subsection when, in the executive director's determination, those other exposure pathways are complete or reasonably anticipated to be completed.

(6) PCLs for the combined exposure pathways of inhalation of volatile emissions and particulates from COCs in surface soil, dermal contact with COCs in surface soil, ingestion of COCs in surface soil, and for affected residential properties, ingestion of aboveground and below-ground vegetables grown in surface soil containing COCs ($^{Tot}Soil_{comb}$). The person shall establish this PCL using the applicable equation as shown in the figure in subsection (b)(1) of this section for Tier 1.

(7) PCLs for groundwater protection from leachate containing COCs from surface and subsurface soil (^{GW}Soil).

(A) The person shall establish ^{GW}Soil for each COC present in the surface and subsurface soil such that soil leachate is protective for:

(i) the critical groundwater PCL established in §350.78 of this title (relating to Determination of Critical Protective Concentration Levels) when the use of a plume management zone is not authorized in §350.33(f)(4) of this title (relating to Remedy Standard B);

(ii) the attenuation action level for the nearest monitoring point when the use of a plume management zone is authorized under §350.33(f)(4) of this title; and/or

(iii) the maximum concentration of COCs in the groundwater source area at the time of RAP submittal when a plume management zone is authorized for class 2 groundwater in response to §350.33(f)(4) of this title.

(B) The person shall establish this PCL using the applicable equations as shown in the figure in subsection (b)(1) of this section for Tier 1.

(C) The person may not be required to establish a soil leachate-to-groundwater PCL in accordance with subparagraphs (A) and (B) of this paragraph when a demonstration can be made with appropriate soil and groundwater monitoring data that the soils will attain the soil response objectives for groundwater protection set forth in Subchapter B of this chapter (relating to Remedy Standards). The determination that the soils are adequately protective shall be based on soil sample data, the concentration trends of groundwater monitoring data over time when groundwater is impacted, probable time since release occurred, adequate identification of the soil source areas, appropriate leachate test results, or other hydrogeologic or property-specific information. The executive director may also require that the change in soil concentrations over time be documented to support this evaluation in a property-specific situation. The executive director may require the person to install a sufficient number of groundwater monitoring wells to demonstrate that groundwater is not affected when soil COC concentration data are inadequate to sufficiently substantiate that groundwater is not affected.

(8) PCLs for inhalation of volatile emissions in outdoor air from COCs in subsurface soils ($^{Air}Soil_{Inh\text{-}V}$). The person shall establish this PCL using the applicable equations as shown in the figure in subsection (b)(1) of this section for Tier 1.

(9) Theoretical soil saturation limit (C_{sat}). The person may establish a property-specific theoretical soil saturation limit for the volatilization exposure pathways required in paragraphs (6) and (8) of this subsection under Tiers 2 or 3. The C_{sat} shall be based on the same property-specific parameters as those used to calculate $^{Air}Soil_{Inh\text{-}V}$. If the property-specific $^{Air}Soil_{Inh\text{-}VP}$ or $^{Air}Soil_{Inh\text{-}V}$ is greater than the property-specific C_{sat}, then that exposure pathway shall not be considered a relevant exposure pathway for that COC.

(10) Residual soil saturation limit ($Soil_{Res}$). The person shall establish the residual saturation level for each organic COC present in surface and subsurface soils which is a liquid at standard temperature and pressure using the applicable equation as shown in the figure in subsection (b)(1) of this section to estimate the mobile NAPL concentration and to determine if NAPL may be present.

(11) PCLs for other complete or reasonably anticipated to be completed surface and subsurface soil exposure pathways. The person shall establish PCLs for surface and subsurface soil exposure pathways other than those listed in paragraphs (6) - (8) of this subsection when, in the executive director's determination, those other exposure pathways are complete or reasonably anticipated to be completed.

(12) Air inhalation exposure pathways ($^{Air}Air_{Inh}$). For air inhalation exposure pathways, the person may be required by the executive director to establish $^{Air}Air_{Inh}$ solely for the purposes of determining the protective concentration that must be met in air at the POE. The person shall use the applicable equation as shown in the figure in subsection (b)(1) of this section to establish $^{Air}Air_{Inh}$.

(13) Surface water exposure pathways (^{SW}SW). The person may be required by the executive director to establish ^{SW}SW when COCs are present in surface water or when COCs will enter into surface water due to a release, and a surface water response action is necessary to protect human or ecological receptors. The person shall use the applicable equation as shown in the figure in subsection (b)(1) of this section to establish ^{SW}SW.

(14) Other air and surface water exposure pathways. The person shall establish PCLs for air and surface water exposure pathways other than those listed in paragraphs (12) and (13) of this subsection when, in the executive director's determination, those other exposure pathways are complete or reasonably anticipated to be completed.

(15) The person shall establish PCLs for complete or reasonably anticipated to be completed sediment exposure pathways when, in the executive director's determination, those exposure pathways are complete or reasonably anticipated to be completed.

(j) The person is not required to combine exposure pathways for a single environmental medium when determining PCLs with the exception of the combined exposure pathway required in subsection (i)(6) of this section, unless otherwise directed by the executive director.

Adopted February 21, 2007 Effective March 19, 2007

§350.76. Approaches for Specific Chemicals of Concern to Determine Human Health Protective Concentration Levels.

(a) General.

(1) Due to the unique nature of the toxicity and/or exposure, the person shall use the COC-specific approaches described in this section for the following COCs:

(A) cadmium;

(B) lead;

(C) polychlorinated biphenyls;

(D) polychlorinated dibenzodioxins and dibenzofurans;

(E) polycyclic aromatic hydrocarbons; and

(F) total petroleum hydrocarbons.

(2) Except for the specific provisions contained in this section, the person shall establish RBELs and PCLs in accordance with the standard procedures outlined in the previous sections of this subchapter.

(3) This section addresses only those exposure pathways for which PCL equations are provided in this subchapter. When dealing with other exposure pathways as required in §350.71(c) of this title (relating to General Requirements), the executive director will specify how those pathways should be addressed for these COCs using the best available science.

(4) The person shall use the figures as required in subsections (b) - (g) of this section.

(b) Cadmium.

(1) In calculating residential soil PCLs that are protective for noncarcinogenic effects for all tiers, the person shall incorporate age-adjusted exposure assumptions for the soil ingestion, vegetable ingestion, and dermal soil exposure pathways. Accordingly, 30 years of cadmium exposure shall be partitioned into three specific exposure periods: <1 - 6 years, 6 - 18 years, and 18 - 30 years. Cadmium intake shall be calculated for each of these periods, based on the period-specific exposure assumptions. The soil PCL for cadmium shall be a function of the final integrated intake estimate, which shall be determined by time-weighting intake from each of the three exposure periods. The age-adjusted RBEL equations and default parameters to be used for cadmium are provided in the following figure. The soil PCL for cadmium shall be calculated by combining the pathway-specific PCLs as outlined in §350.75(i)(6) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation).

Age-Adjusted RBEL Equations and Default Exposure Factors for Evaluating the Noncarcinogenic Effects of Cadmium
Residential Land Use

Dermal Contact with Non-Carcinogenic COCs in Soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Derm\text{-}nc} = \frac{HQ \times RfD_d \times AT.AgeAdj.res \times 365\ days/yr}{10^{-6}\ kg/mg \times EF.res \times DF.adj \times ABS.d}$$

Ingestion of Non-Carcinogenic COCs in Soil - RBEL (mg/kg)

$$^{Soil}RBEL_{Ing\text{-}nc}(mg/kg) = \frac{HQ \times RfD_o \times AT.AgeAdj.res \times 365\ days/yr}{10^{-6}\ kg/mg \times EF.res \times IRsoil.AgeAdj.res \times RBAF}$$

Ingestion of Non-Carcinogenic COCs in Above-Ground Vegetables - RBEL (mg/kg)

$$^{Abg}RBEL_{Ing\text{-}nc} = \frac{HQ \times RfD_o \times AT.AgeAdj.res \times 365\ day/yr}{EF.res \times IRabg.AgeAdj.res}$$

Ingestion of Non-Carcinogenic COCs in Below-Ground Vegetables - RBEL (mg/kg)

$$^{Bg}RBEL_{Ing\text{-}nc} = \frac{HQ \times RfD_o \times AT.AgeAdj.res \times 365\ day/yr}{EF.res \times IRbg.AgeAdj.res}$$

HQ	Hazard Quotient (unitless)	1
AT.AgeAdj.res	Averaging Time - (yr)-Age-adjusted	30
RfD_o	Oral Reference Dose (mg/kg-day)	Chemical Specific
RfD_d	Dermal Reference Dose (mg/kg-day)	Chemical Specific
EF.res	Exposure Frequency (days/yr) (event/yr for dermal soil)	350
DF.adj	Dermal Adjustment Factor (mg-yr/kg-event)	352
ABS.d	Dermal Absorption Fraction (unitless)	Chemical Specific

Irsoil.AgeAdj.res	Age-Adjusted Soil Ingestion Rate (mg-yr/kg-day)	120
	Age-Adjusted Vegetable Ingestion Rate (kg-yr/kg-day)	
IRabg.AgeAdj.res	Above-Ground Vegetables	0.0028
IRbg.AgeAdj.res	Below-Ground Vegetables	0.0012
RBAF	Relative Bioavailability Factor	1

(2) In calculating residential and commercial/industrial soil PCLs for all tiers, the person shall use the reference dose values for cadmium in food in evaluating exposures to cadmium through the soil ingestion, vegetable ingestion, and dermal soil exposure pathways.

(c) Lead.

(1) The Tier 1 residential soil PCL ($^{Tot}Soil_{Comb}$) for lead is 500 mg/kg.

(2) Subject to prior approval by the executive director, the person may use property-specific data in conjunction with a lead model approved by the executive director (e.g., EPA Integrated Exposure Uptake Biokinetic model for lead in children (version 1.0 from 2005)) to calculate a Tier 3 residential soil PCL ($^{Tot}Soil_{Comb}$) for lead. The person shall submit information to the executive director which demonstrates that variance from default model inputs is supported by property-specific information (e.g., data from a scientifically valid bioavailability study using property-specific soils). Property-specific model input values must be approved by the executive director. Consistent with the development of residential RBELs for COCs without chemical-specific approaches in accordance with §350.74 of this title (Development of Risk-Based Exposure Limits**)**, variance from certain model default exposure factors such as soil/dust ingestion rates and exposure frequency to less conservative (i.e., lower) numerical values shall not be allowed.

(3) The commercial/industrial soil PCL ($^{Tot}Soil_{Comb}$) is based only on the soil ingestion pathway ($^{Soil}Soil_{Ing}$). The person shall use the exposure algorithm and default exposure factors in the following figure for calculating the Tier 1 commercial/industrial $^{Soil}RBEL_{Ing}$ value.

Equation for Adult Lead Exposure Commercial/Industrial Land Use (Tier 1)
$^{Soil}Soil_{Ing}=^{Soil}RBEL_{Ing}$
$$^{Soil}RBEL_{Ing}(\mu g/g)=\frac{\left(PbB_{95}\,fetal/\left(R\times\left(GSD_i\right)^{1.645}\right)\right)-PbB0}{BKSF\times\left(IR_{sd}\times AF_{sd}\times EF_{sd}/365\right)}$$

Parameter	Definition (units)	Default
PbB_{95} fetal	95th Percentile PbB in Fetus (µg/dL)	10
R	Mean Ratio of Fetal to Maternal PbB	0.9
GSD_i	Individual Geometric Standard Deviation	1.91
PbB0	Baseline Blood Lead Value (µg/dL)	1.64
BKSF	Biokinetic Slope Factor (µg/dL per µg/day)	0.4
IR_{sd}	Soil/Dust Ingestion Rate (g/day)	0.05
EF_{sd}	Soil/Dust Exposure Frequency (days/yr)	250
AF_{sd}	Absolute Absorption Fraction of Lead in Soil/Dust	0.10

(4) The person may use a different exposure algorithm as presented in the following figure that considers soil and dust separately for calculating the Tier 2 and 3 commercial/industrial $^{Soil}RBEL_{Ing}$ value in cases where the person has adequate direct measurement data on the concentrations of lead in both soil and dust at the affected property. In addition, in calculating Tier 2 or 3 $^{Soil}RBEL_{Ing}$ values, the person may deviate from the default exposure factors as shown in the figure in paragraph (3) of this subsection and the following figure if property-specific or defensible alternative data (e.g., from open literature or privately funded studies) adequately support such an approach. The specific exposure factors for which the person may use property-specific or scientifically defensible alternative values are the following:

Equation for Adult Lead Exposure Commercial/Industrial Land Use (Tiers 2 & 3 only)		
$^{Soil}Soil_{Ing} = {}^{Soil}RBEL_{Ing}$		
$${}^{Soil}RBEL_{Ing}(\mu g/g) = \frac{\left(PbB_{95}\,fetal/\left(R\times(GSD_i)^{1.645}\right)\right)-PbB0}{BKSF\times\left(\left(IR_{sf}\times AF_s\times EF_{s/365}\right)+\left(K_{sd}\times IR_d\times AF_d\times EF_d/365\right)\right)}$$		
Parameter	**Definition (units)**	**Defaults**
PbB_{95} fetal	95th Percentile PbB in Fetus (µg/dL)	10
R	Mean Ratio of Fetal to Maternal PbB	0.9
GSD_i	Individual Geometric Standard Deviation	1.91
PbB0	Baseline Blood Lead Value (µg/dL)	1.64
BKSF	Biokinetic Slope Factor (µg/dL per µg/day)	0.4
IR_s	Soil Ingestion Rate (g/day)	0.025
IR_d	Dust Ingestion Rate (g/day)	0.025
K_{sd}	Ratio of Concentration in Dust to that in Soil	***
EF_s	Soil Exposure Frequency (days/yr)	250
EF_d	Dust Exposure Frequency (days/yr)	250
AF_s	Absolute Absorption Fraction of Lead in Soil	0.10
AF_d	Absolute Absorption Fraction of Lead in Dust	0.10
***Based on direct measurement data on the concentrations of lead in both soil and dust at the affected property.		

(A) individual geometric standard deviation (GSD_i);

(B) baseline blood lead (PbBO);

(C) absolute absorption fraction of lead in soil/dust (Afsd);

(D) absolute absorption fraction of lead in soil (AFs); and

(E) absolute absorption fraction of lead in dust (Afd).

(d) Polychlorinated Biphenyls.

(1) In calculating Tier 1 residential and commercial/industrial soil and groundwater PCLs, the person shall use the upper-reference point of the upper-bound slope factors (2 $(mg/kg\text{-}day)^{-1}$) for the soil ingestion, dermal contact with soil, vegetable ingestion, and inhalation (both vapor and particulate phases) exposure pathways.

(2) For Tiers 2 and 3, the person may use alternative slope factors when the following conditions are met:

(A) The person may use the lower reference point of the upper bound slope factors (0.4 $(mg/kg\text{-}day)^{-1}$) to calculate an inhalation unit risk factor when evaluating inhalation exposures to volatilized polychlorinated biphenyls. The person must still use the upper reference point of the upper bound slope factors (2 $(mg/kg\text{-}day)^{-1}$) to evaluate inhalation exposures to particulate phase polychlorinated biphenyls.

(B) The person may conduct congener or isomer analyses. The person may use the lowest reference point of the upper-bound slope factors (0.07 $(mg/kg\text{-}day)^{-1}$) for the soil ingestion, dermal contact with soil, and inhalation exposure pathways if congener or isomer analyses verify that congeners with more than four chlorines comprise less than one-half percent of total polychlorinated biphenyls in a given exposure medium. The upper reference point of the upper-bound slope factors (2 $(mg/kg\text{-}day)^{-1}$) shall be used for all other exposure pathways regardless of the results of the congener- or isomer-specific analyses. If congener or isomer analyses indicate that congeners with more than four chlorines comprise greater than one-half percent of total polychlorinated biphenyls in a given exposure medium, then the person shall use the upper-reference point of the upper-bound slope factors (2 $(mg/kg\text{-}day)^{-1}$) for all pathways for that specific exposure medium. Further, when congener concentrations are available, the contribution of dioxin-like polychlorinated biphenyls to total dioxin equivalents shall be considered. The person shall apply the toxicity equivalency factors specified in the following figure to the measured concentrations for each of the dioxin-like polychlorinated biphenyls. These values shall then be summed to obtain a 2,3,7,8-TCDD toxicity equivalency quotient. Toxicity equivalency quotients for dioxin-like polychlorinated biphenyls shall then be added to those for other dioxin-like compounds as specified in subsection (e) of this section to yield a total toxicity equivalency quotient concentration. This total toxicity equivalency quotients concentration shall then be compared with the critical PCL for TCDD, 2,3,7,8- (dioxin). When addressing dioxin-like polychlorinated biphenyls in this manner, the person shall subtract the concentration of dioxin-like polychlorinated biphenyls from the total polychlorinated biphenyls concentration to avoid overestimating dioxin-like polychlorinated biphenyls by evaluating them twice.

Toxicity Equivalency Factors (TEFs) for Dioxin-Like Compounds	
Congener/Class	**TEF Value**
2,3,7,8-Substituted Dibenzodioxins	
2,3,7,8-Tetrachlorodibenzodioxin	1
2,3,7,8-Pentachlorodibenzodioxins	1
2,3,7,8-Hexachlorodibenzodioxins	0.1
2,3,7,8-Heptachlorodibenzodioxins	0.01
Octachlorodibenzodioxins	0.0001
2,3,7,8-Substituted Dibenzofurans	
2,3,7,8-Tetrachlorodibenzofuran	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.05
2,3,4,7,8-Pentachlorodibenzofuran	0.5
2,3,7,8-Hexachlorodibenzofurans	0.1
2,3,7,8-Heptachlorodibenzofurans	0.01
Octachlorodibenzofurans	0.0001
Dioxin-Like PCBs	
3,4,4',5-TCB (81)	0.0001
3,3',4,4'-TCB (77)	0.0001
3,3',4,4',5-PeCB (126)	0.1
3,3',4,4',5,5'-HxCB (169)	0.01
2,3,3',4,4'-PeCB (105)	0.0001
2,3,4,4',5-PeCB (114)	0.0005
2,3',4,4',5-PeCB (118)	0.0001
2',3,4,4',5-PeCB (123)	0.0001
2,3,3',4,4',5-HxCB (156)	0.0005
2,3,3',4,4',5'-HxCB (157)	0.0005
2,3',4,4',5,5'-HxCB (167)	0.00001
2,3,3',4,4',5,5'-HpCB (189)	0.0001

(3) In evaluating inhalation exposures under Tiers 2 or 3, the person shall convert the appropriate slope factor to an inhalation unit risk factor, based on the following equation: Inhalation Unit Risk Factor (risk per $\mu g/m^3$)= oral slope factor x 20 m^3/day divided by 70 kg x 10^{-3} mg/µg.

(4) In Tiers 2 and 3, and only when applicable for a specific site, the person may set soil PCLs based on the requirements of the Toxic Substances Control Act, 40 Code of Federal Regulations Parts 750 and 761, as amended. Sites must comply fully with all applicable Toxic Substances Control

Act, as amended, requirements when establishing the soil PCL for polychlorinated biphenyls in this manner.

(e) Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans.

(1) In demonstrating attainment of the critical PCL for TCDD, 2,3,7,8- (dioxin), the person shall apply the toxicity equivalency factor as shown in the figure in subsection (d)(2)(B) of this section to the measured concentrations in accordance with the following procedures.

(A) When analytical data are only available for total dioxins/furans, the person shall assume that the mixture consists solely of 2,3,7,8-TCDD, and a toxicity equivalency factor value of 1.0 shall be applied to the measured concentration to yield the 2,3,7,8-TCDD toxicity equivalency quotient concentration for the sample.

(B) When homologue-specific analytical data are available (e.g., tetrachlorodibenzodioxins), the person shall assume that each homologue class is comprised solely of 2,3,7,8-substituted congeners, and the toxicity equivalency factor specified for the 2, 3, 7, 8-substituted congeners in the homologue class shall be applied to the measured concentrations for that homologue class. A toxicity equivalency factor value of 0.5 should be used for the pentachlorodibenzofuran homologue class. The toxicity equivalency quotient concentrations for each homologue class shall be summed to obtain a total toxicity equivalency quotient concentration for the sample.

(C) When congener-specific analytical data are available (e.g., 1, 2, 3, 4, 7, 8-hexachlorodibenzofuran), the person shall apply the toxicity equivalency factor for the 2, 3, 7, 8-substituted congeners to the measured concentrations. The toxicity equivalency quotient concentrations for each 2, 3, 7, 8-substituted congener shall then be summed to obtain a total toxicity equivalency quotient concentration for the sample.

(2) The person shall then compare the total toxicity equivalency quotient concentration established in paragraph (1) of this subsection to the critical PCL for TCDD, 2, 3, 7, 8- (dioxins).

(3) The critical soil PCL for residential properties for all three tiers is 1 part per billion (ppb) and for commercial/industrial properties for all three tiers is 5 ppb.

(f) Polycyclic Aromatic Hydrocarbons.

(1) In calculating residential and commercial/industrial PCLs for all tiers, the person shall evaluate the following seven polycyclic aromatic hydrocarbons as carcinogens:

(A) benzo {a} anthracene;

(B) benzo {b} fluoranthene;

(C) benzo {k} fluoranthene;

(D) benzo {a} pyrene (B {a} P);

(E) chrysene;

(F) dibenzo {a, h} anthracene; and

(G) indeno {1, 2, 3-c, d} pyrene.

(2) The person shall use the relative potency factors outlined in the following figure to estimate cancer slope factors and unit risk estimates for each of the polycyclic aromatic hydrocarbons identified in paragraph (1) of this subsection for all exposure pathways (e.g., the soil ingestion, vegetable ingestion, inhalation, dermal contact with soil, and groundwater ingestion (in the absence of a primary MCL) exposure pathways):

Relative Potency Factors (RPF) for Carcinogenic PAHs	
Compound	**RPF**
Benz{a}anthracene	0.1
Benzo{a}pyrene	1
Benzo{b}fluoranthene	0.1
Benzo{k}fluoranthene	0.01
Chrysene	0.001
Dibenz{a,h}anthracene	1
Indeno{1,2,3-c,d}pyrene	0.1

(3) The cancer slope factors and inhalation unit risk factors for the seven carcinogenic polycyclic aromatic hydrocarbons, shall be calculated according to the equations set forth in the following figure:

Equations for Calculating Cancer Slope Factors and Unit Risk Factors for Carcinogenic PAHs

$$SF_{PAH} = (SF_{B[a]P})\ (RPF_{PAH})$$

where:
SF_{PAH} = adjusted cancer slope factor for a PAH $(mg/kg\text{-}day)^{-1}$
$SF_{B[a]P}$ = cancer slope factor for benzo{a}pyrene $(mg/kg\text{-}day)^{-1}$
RPF_{PAH} = relative potency factor for a PAH in Figure 30 TAC §350.76(f)(2) (unitless)

$$URF_{PAH} = (URF_{B[a]P})\ (RPF_{PAH})$$

where:
URF_{PAH} = adjusted inhalation unit risk factor for a PAH $(\mu g/m^3)^{-1}$
$URF_{B[a]P}$ = inhalation unit risk factor for benzo{a}pyrene $(\mu g/m^3)^{-1}$
RPF_{PAH} = relative potency factor for a PAH in (Figure 30 TAC §350.76(f)(2)) (unitless)

(4) The person shall not apply the relative potency factor for any pathways when evaluating noncarcinogenic endpoints.

(5) For class 1 or 2 groundwater, the person shall establish PCLs according to the procedures in subparagraphs (A) and (B) of this paragraph.

(A) In evaluating residential and commercial/industrial exposures to class 1 and 2 groundwater for all tiers, the person shall use the most currently available primary MCL for benzo{a}pyrene as ${}^{GW}GW_{Ing}$ for benzo{a}pyrene.

(B) In establishing ${}^{GW}GW_{Ing}$ for class 1 and 2 groundwater for the six remaining carcinogenic polycyclic aromatic hydrocarbons, the person shall use the higher of the calculated ${}^{GW}RBEL_{Ing}$ or the primary MCL for B{a}P as ${}^{GW}GW_{Ing}$ for that specific polycyclic aromatic hydrocarbon. In the event that primary MCLs for the other carcinogenic polycyclic aromatic hydrocarbons become available, those MCLs would serve as ${}^{GW}GW_{Ing}$ for these compounds.

(g) Total Petroleum Hydrocarbons.

(1) The person shall follow the methodology prescribed by this subsection to establish PCLs for total petroleum hydrocarbons, unless the executive director approves the use of an alternate method.

(2) In order to establish PCLs for total petroleum hydrocarbons, the person shall establish PCLs for each of the aliphatic and aromatic hydrocarbon fractions listed in the following figure (e.g., aliphatic $>C_6$-C_8) for the mandatory and complete or reasonably anticipated to be completed exposure pathways as required in §350.71(c) of this title (relating to General Requirements):

Hydrocarbon Fractions and Toxicity Factors		
Aliphatic Hydrocarbon Fraction	Surrogate for Oral RfD	Surrogate for Inhalation RfC
C_6	n-hexane	n-hexane[1] commercial hexane[2]
$>C_6$-C_8	n-hexane	n-hexane[1] commercial hexane[2]
$>C_8$-C_{10}	C9-C17 aliphatics	dearomatized white spirits
$>C_{10}$-C_{12}	C9-C17 aliphatics	dearomatized white spirits
$>C_{12}$-C_{16}	C9-C17 aliphatics	dearomatized white spirits
$>C_{16}$-C_{21}	white mineral oils	----
$>C_{16}$-C_{21} (for transformer mineral oil releases only)	transformer mineral oil	----
$>C_{21-35}$ [3]	white mineral oil	----
$>C_{21}$-C_{35} (for transformer mineral oil releases only)	transformer mineral oil	----
Aromatic Hydrocarbon Fraction	Surrogate for Oral RfD	Surrogate for Inhalation RfC
$>C_{7-8}$	ethylbenzene	ethylbenzene
$>C_8$-C_{10}	multiple aromatic compounds	high flash aromatic naphtha
$>C_{10}$-C_{12}	multiple aromatic compounds	high flash aromatic naphtha
$>C_{12}$-C_{16}	multiple aromatic compounds	multiple aromatic compounds
$>C_{16}$-C_{21}	pyrene	----
$>C_{21}$-C_{35} [3]	pyrene	----

Footnotes:

1. For mixtures with greater than 53% n-hexane content.
2. For mixtures with less than or equal to 53% n-hexane content.
3. The person may truncate the analysis at C_{28} when there does not appear to be significant mass of $>C_{28}$ based on the gas chromatogram and the product is anticipated to be a lighter hydrocarbon (e.g., gasoline, diesel, not transformer mineral oil, or used motor oil).

(3) The person shall use the specific toxicity factors for the specific surrogates as shown in the figure in paragraph (2) of this subsection for a hydrocarbon fraction. If a reference concentration is not available, then the person shall not be required to comply with §350.73(c) of this title (relating to Determination and Use of Human Toxicity Factors and Chemical Properties). The PCLs established under this subsection shall be based on noncarcinogenic effects.

(4) The person shall ensure that the PCLs established for each hydrocarbon fraction comply with the hazard quotient criteria as set forth in §350.72 of this title (relating to Carcinogenic Risk Levels and Hazard Indices for Human Health Exposure Pathways).

(5) The person shall ensure that the PCLs established for the total petroleum hydrocarbons comply with the hazard index criteria as set forth in §350.72 of this title considering only the hydrocarbon fractions as shown in the figure in paragraph (2) of this subsection. The person shall follow the methodology prescribed in §350.72(d) of this title to adjust the hydrocarbon fraction PCLs to meet the hazard index criteria for the total petroleum hydrocarbons.

(6) The person shall use an analytical method approved by the executive director to determine the concentration of the hydrocarbon fractions at the affected property.

(7) When the bulk total petroleum hydrocarbons composition can be assumed to be relatively consistent based on process knowledge, the person may establish mixture-specific (e.g., gasoline, diesel, transformer mineral oil, or other petroleum product) PCLs based on property-specific mixture compositions or mixture compositions considered to be representative of the mixture. The person shall comply with the other provisions of this subsection in the development of the mixture-specific PCLs, but the person shall be allowed to determine compliance with the mixture-specific total petroleum hydrocarbons PCL with a bulk total petroleum hydrocarbons analytical method acceptable to the executive director in lieu of analysis of the concentration of each hydrocarbon fraction.

(8) The PCLs established for each individual aliphatic and aromatic hydrocarbon fraction used to establish the mixture specific PCLs shall not exceed a hazard quotient of 1 and the mixture-specific PCL shall not exceed a hazard index of 10.

§350.77. Ecological Risk Assessment and Development of Ecological Protective Concentration Levels.

(a) General. The person shall evaluate the affected property by conducting an ecological risk assessment in a manner appropriate and consistent with subsections (b), (c), or (d) of this section. The process is discussed in the agency's ecological risk assessment guidance. The purpose of the ecological risk assessment will be to characterize the ecological setting of the affected property, identify complete or reasonably anticipated to be completed exposure pathways and representative ecological receptors, scientifically eliminate COCs that pose no unacceptable risk, and develop PCLs for selected ecological receptors where warranted. The POEs for the selected ecological receptors shall be established on a property-specific basis. However, if the person can show that no unacceptable ecological risk exists due to incomplete or insignificant exposure pathways as specified in subsection (b) of this section, or if all COCs can be eliminated as specified in subsection (c)(1), (6), (7), or (8) of this section, or if, after incorporation of site-specific information, it can be shown that there is either no ecological risk or that it is not apparent as specified in subsection (d) of this section, then the ecological risk assessment process will terminate at that point. Also, if after the ecological risk assessment process specified in subsection (b) of this section, or if at anytime during the ecological risk assessment process specified in subsections (c) or (d) of this section, the person can demonstrate to the satisfaction of the executive director that the implementation of a response action will eliminate the ecological exposure pathway or render it insignificant, or that human health PCLs will be protective of ecological receptors, then no further ecological risk assessment evaluation will be required. In addition, if after the ecological risk assessment process specified in subsection (b) of this section, the person can demonstrate to the satisfaction of the executive director that an expedited stream evaluation can determine that the completed surface water and sediment pathways are insignificant, then no further ecological risk assessment evaluation will be required. If no further ecological risk assessment evaluation is required, then the person shall provide, as appropriate, a reasoned justification and/or an expedited stream evaluation for terminating the ecological risk assessment and place this information in the affected property assessment report as described in §350.91 of this title (relating to Affected Property Assessment Report). Furthermore, after ecological PCLs have been established, the person shall have the option, where determined appropriate, of conducting an ecological services analysis as a means of managing ecological risk at the affected property, in accordance with subsection (f) of this section and §350.33(a)(3)(B) of this title (relating to Remedy Standard B). Subsections (b), (c), and (d) of this section describe a three-tiered approach to conducting an ecological risk assessment, and although there is a logical progression from one tier to the next, the person may begin the ecological evaluation of the affected property at any tier.

(b) Tier 1: exclusion criteria checklist. The person shall conduct a Tier 1 assessment at all affected properties to which this rule is applicable as presented in §350.2 of this title (relating to Applicability), unless the person elects to begin the ecological evaluation at Tier 2 or Tier 3. The person shall use the Tier 1 Exclusion Criteria Checklist provided in the following figure. The person will have fulfilled the ecological risk assessment requirements if the affected property meets the exclusion criteria. However, the person shall re-enter the ecological risk assessment process if changing circumstances result in the affected property not meeting the Tier 1 exclusion criteria. The person is required to continue the ecological risk assessment process as described in subsection (c) or (d) of this section if the affected property fails the exclusion criteria, unless the reasoned justification and/or expedited stream evaluation processes described in subsection (a) of this section are used to demonstrate that no unacceptable ecological risk exists.

Figure: 30 TAC §350.77(b)

TIER 1: EXCLUSION CRITERIA CHECKLIST

This exclusion criteria checklist is intended to aid the person and the TCEQ in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program (TRRP). Exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment (ERA) because there are **incomplete or insignificant ecological exposure pathways** due to the nature of the affected property setting and/or the condition of the affected property media. This checklist (and/or a Tier 2 or 3 ERA or the equivalent) must be completed by the person for all affected property subject to the TRRP. The person should be familiar with the affected property but need not be a professional scientist in order to respond, although some questions will likely require contacting a wildlife management agency (i.e., Texas Parks and Wildlife Department or U.S. Fish and Wildlife Service). The checklist is designed for general applicability to all affected property; however, there may be unusual circumstances which require professional judgement in order to determine the need for further ecological evaluation (e.g., cave-dwelling receptors). In these cases, the person is strongly encouraged to contact TCEQ before proceeding.

Besides some preliminary information, the checklist consists of three major parts, **each of which must be completed unless otherwise instructed.** PART I requests affected property identification and background information. PART II contains the actual exclusion criteria and supportive information. PART III is a qualitative summary statement and a certification of the information provided by the person. **Answers should reflect existing conditions and should not consider future remedial actions at the affected property.** Completion of the checklist should lead to a logical conclusion as to whether further evaluation is warranted. Definitions of terms used in the checklist have been provided and users are strongly encouraged to familiarize themselves with these definitions before beginning the checklist.

Name of Facility:

Affected Property Location:

Mailing Address:

TCEQ Case Tracking #s:

Solid Waste Registration #s:

Voluntary Cleanup Program #:

EPA I.D. #s:

Definitions[1]

Affected property - The entire area (i.e., on-site and off-site; including all environmental media) which contains releases of chemicals of concern at concentrations equal to or greater than the assessment level applicable for residential land use and groundwater classification.

Assessment level - A critical protective concentration level for a chemical of concern used for affected property assessments where the human health protective concentration level is established under a Tier 1 evaluation as described in §350.75(b) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation), except for the protective concentration level for the soil-to-groundwater exposure pathway which may be established under Tier 1, 2, or 3 as described in §350.75(i)(7) of this title, and ecological protective concentration levels which are developed, when necessary, under Tier 2 and/or 3 in accordance with §350.77(c) and/or (d), respectively, of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels).

Bedrock - The solid rock (i.e., consolidated, coherent, and relatively hard naturally formed material that cannot normally be excavated by manual methods alone) that underlies gravel, soil or other surficial material.

Chemical of concern - Any chemical that has the potential to adversely affect ecological or human receptors due to its concentration, distribution, and mode of toxicity. Depending on the program area, chemicals of concern may include the following: solid waste, industrial solid waste, municipal solid waste, and hazardous waste as defined in Texas Health and Safety Code, §361.003, as amended; hazardous constituents as listed in 40 Code of Federal Regulations Part 261, Appendix VIII, as amended; constituents on the groundwater monitoring list in 40 Code of Federal Regulations Part 264, Appendix IX, as amended; constituents as listed in 40 CFR Part 258 Appendices I and II, as amended; pollutant as defined in Texas Water Code, §26.001, as amended; hazardous substance as defined in Texas Health and Safety Code, §361.003, as amended, and the Texas Water Code, §26.263, as amended; other substances as defined in Texas Water Code, §26.039(a), as amended; and daughter products of the aforementioned constituents.

Community - An assemblage of plant and animal populations occupying the same habitat in which the various species interact via spatial and trophic relationships (e.g., a desert community or a pond community).

Complete exposure pathway - An exposure pathway where a human or ecological receptor is exposed to a chemical of concern via an exposure route (e.g., incidental soil ingestion, inhalation of volatiles and particulates, consumption of prey, etc).

De minimus **-** The description of an area of affected property comprised of one acre or less where the ecological risk is considered to be insignificant because of the small extent of contamination, the absence of protected species, the availability of similar unimpacted habitat nearby, and the lack of adjacent sensitive environmental areas.

Ecological protective concentration level - The concentration of a chemical of concern at the point of exposure within an exposure medium (e.g., soil, sediment, groundwater, or surface water) which is determined in accordance with §350.77(c) or (d) of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels) to be protective for ecological receptors.

These concentration levels are primarily intended to be protective for more mobile or wide-ranging ecological receptors and, where appropriate, benthic invertebrate communities within the waters in the state. These concentration levels are not intended to be directly protective of receptors with limited mobility or range (e.g., plants, soil invertebrates, and small rodents), particularly those residing within active areas of a facility, unless these receptors are threatened/endangered species or unless impacts to these receptors result in disruption of the ecosystem or other unacceptable consequences for the more mobile or wide-ranging receptors (e.g., impacts to an off-site grassland habitat eliminate rodents which causes a desirable owl population to leave the area).

Ecological risk assessment - The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors; however, as used in this context, only chemical stressors (i.e., COCs) are evaluated.

Environmental medium - A material found in the natural environment such as soil (including non-waste fill materials), groundwater, air, surface water, and sediments, or a mixture of such materials with liquids, sludges, gases, or solids, including hazardous waste which is inseparable by simple mechanical removal processes, and is made up primarily of natural environmental material.

Exclusion criteria - Those conditions at an affected property which preclude the need to establish a protective concentration level for an ecological exposure pathway because the exposure pathway between the chemical of concern and the ecological receptors is not complete or is insignificant.

Exposure medium - The environmental medium or biologic tissue in which or by which exposure to chemicals of concern by ecological or human receptors occurs.

Facility - The installation associated with the affected property where the release of chemicals of concern occurred.

Functioning cap - A low permeability layer or other approved cover meeting its design specifications to minimize water infiltration and chemical of concern migration, and prevent ecological or human receptor exposure to chemicals of concern, and whose design requirements are routinely maintained.

Landscaped area - An area of ornamental, or introduced, or commercially installed, or manicured vegetation which is routinely maintained.

Off-site property (off-site) - All environmental media which is outside of the legal boundaries of the on-site property.

On-site property (on-site) - All environmental media within the legal boundaries of a property owned or leased by a person who has filed a self-implementation notice or a response action plan for that property or who has become subject to such action through one of the agency's program areas for that property.

Physical barrier - Any structure or system, natural or manmade, that prevents exposure or prevents migration of chemicals of concern to the points of exposure.

Point of exposure - The location within an environmental medium where a receptor will be assumed to

have a reasonable potential to come into contact with chemicals of concern. The point of exposure may be a discrete point, plane, or an area within or beyond some location.

Protective concentration level - The concentration of a chemical of concern which can remain within the source medium and not result in levels which exceed the applicable human health risk-based exposure limit or ecological protective concentration level at the point of exposure for that exposure pathway.

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, with the exception of:

(A) A release that results in an exposure to a person solely within a workplace, concerning a claim that the person may assert against the person's employer;

(B) An emission from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine;

(C) A release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined by the Atomic Energy Act of 1954, as amended (42 U.S.C. §2011 *et seq*.), if the release is subject to requirements concerning financial protection established by the Nuclear Regulatory Commission under §170 of that Act;

(D) For the purposes of the environmental response law §104, as amended, or other response action, a release of source, by-product, or special nuclear material from a processing site designated under §102(a)(1) or §302(a) of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. §7912 and §7942), as amended; and

(E) The normal application of fertilizer.

Sediment - Non-suspended particulate material lying below surface waters such as bays, the ocean, rivers, streams, lakes, ponds, or other similar surface water body (including intermittent streams). Dredged sediments which have been removed from below surface water bodies and placed on land shall be considered soils.

Sensitive environmental areas - Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young, and overwintering. Examples include critical habitat for threatened and endangered species, wilderness areas, parks, and wildlife refuges.

Source medium - An environmental medium containing chemicals of concern which must be removed, decontaminated and/or controlled in order to protect human health and the environment. The source medium may be the exposure medium for some exposure pathways.

Stressor - Any physical, chemical, or biological entity that can induce an adverse response; however, as used in this context, only chemical entities apply.

Subsurface soil - For human health exposure pathways, the portion of the soil zone between the base of surface soil and the top of the groundwater-bearing unit(s). For ecological exposure pathways, the portion of the soil zone between 0.5 feet and 5 feet in depth.

Surface cover - A layer of artificially placed utility material (e.g., shell, gravel).

Surface soil - For human health exposure pathways, the soil zone extending from ground surface to 15 feet in depth for residential land use and from ground surface to 5 feet in depth for commercial/industrial land use; or to the top of the uppermost groundwater-bearing unit or bedrock, whichever is less in depth. For ecological exposure pathways, the soil zone extending from ground surface to 0.5 feet in depth.

Surface water - Any water meeting the definition of surface water in the state as defined in §307.3 of this title (relating to Abbreviations and Definitions), as amended.

PART I. Affected Property Identification and Background Information

1) Provide a description of the specific area of the response action and the nature of the release. Include estimated acreage of the affected property and the facility property, and a description of the type of facility and/or operation associated with the affected property. Also describe the location of the affected property with respect to the facility property boundaries and public roadways.

Attach available USGS topographic maps and/or aerial or other affected property photographs to this form to depict the affected property and surrounding area. Indicate attachments:

□ Topo map □ Aerial photo □ Other

2) Identify environmental media known or suspected to contain chemicals of concern (COCs) at the present time. Check all that apply:

Known/Suspected COC Location	Based on sampling data?	
□ Soil <5 ft below ground surface	□ Yes	□ No
□ Soil >5 ft below ground surface	□ Yes	□ No
□ Groundwater	□ Yes	□ No
□ Surface Water/Sediments	□ Yes	□ No

Explain (previously submitted information may be referenced):

3) Provide the information below for the nearest surface water body which has become or has the potential to become impacted from migrating COCs via surface water runoff, air deposition, groundwater seepage, etc. Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

The nearest surface water body is feet/miles from the affected property and is named . The water body is best described as a:

- ☐ freshwater stream: perennial (has water all year)
  intermittent (dries up completely for at least 1 week a year)
  intermittent with perennial pools
- ☐ freshwater swamp/marsh/wetland
- ☐ saltwater or brackish marsh/swamp/wetland
- ☐ reservoir, lake, or pond; approximate surface acres:
- ☐ drainage ditch
- ☐ tidal stream ☐ bay ☐ estuary
- ☐ other; specify

Is the water body listed as a State classified segment in Appendix C of the current Texas Surface Water Quality Standards; §§307.1 - 307.10?

☐ Yes Segment # Use Classification:

☐ No

If the water body is not a State classified segment, identify the first downstream classified segment.

Name:

Segment #:

Use Classification:

As necessary, provide further description of surface waters in the vicinity of the affected property:

PART II. Exclusion Criteria and Supportive Information
Subpart A. Surface Water/Sediment Exposure

1) Regarding the affected property where a response action is being pursued under the TRRP, have COCs migrated and resulted in a release or imminent threat of release to either surface waters or to their associated sediments via surface water runoff, air deposition, groundwater seepage, etc.? Exclude wastewater treatment facilities and storm water conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are

ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

□ Yes □ No

Explain:
If the answer is Yes to Subpart A above, the affected property does not meet the exclusion criteria. However, complete the remainder of Part II to determine if there is a complete and/or significant soil exposure pathway, then complete PART III - Qualitative Summary and Certification. If the answer is No, go to Subpart B.

Subpart B. Affected Property Setting

In answering "Yes" to the following question, it is understood that the affected property is not attractive to wildlife or livestock, including threatened or endangered species (i.e., the affected property does not serve as valuable habitat, foraging area, or refuge for ecological communities). (May require consultation with wildlife management agencies.)

1) Is the affected property wholly contained within contiguous land characterized by: pavement, buildings, landscaped area, functioning cap, roadways, equipment storage area, manufacturing or process area, other surface cover or structure, or otherwise disturbed ground?

□ Yes □ No

Explain:

If the answer to Subpart B above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subparts C and D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart B above is No, go to Subpart C.

Subpart C. Soil Exposure
1) Are COCs which are in the soil of the affected property solely below the first 5 feet beneath ground surface **or** does the affected property have a physical barrier present to prevent exposure of receptors to COCs in surface soil?

□ Yes □ No
Explain:

If the answer to Subpart C above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subpart D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart C above is No, proceed to Subpart D.

Subpart D. *De Minimus* Land Area

In answering "Yes" to the question below, it is understood that all of the following conditions apply:

The affected property is not known to serve as habitat, foraging area, or refuge to threatened/endangered or otherwise protected species. (Will likely require consultation with wildlife management agencies.)

Similar but unimpacted habitat exists within a half-mile radius.

The affected property is not known to be located within one-quarter mile of sensitive environmental areas (e.g., rookeries, wildlife management areas, preserves). (Will likely require consultation with wildlife management agencies.)

There is no reason to suspect that the COCs associated with the affected property will migrate such that the affected property will become larger than one acre.

1) Using human health protective concentration levels as a basis to determine the extent of the COCs, does the affected property consist of one acre or less and does it meet all of the conditions above?

□ Yes □ No

Explain how conditions are met/not met:

If the answer to Subpart D above is Yes, then no further ecological evaluation is needed at this affected property, assuming the answer to Subpart A was No. Complete PART III - Qualitative Summary and Certification. If the answer to Subpart D above is No, proceed to Tier 2 or 3 or comparable ERA.

PART III. Qualitative Summary and Certification (Complete in all cases.)

Attach a brief statement (not to exceed 1 page) summarizing the information you have provided in this form. This summary should include sufficient information to verify that the affected property meets or does not meet the exclusion criteria. The person should make the initial decision regarding the need for further ecological evaluation (i.e., Tier 2 or 3) based upon the results of this checklist. After review, TCEQ will make a final determination on the need for further assessment. **Note that the person has the continuing obligation to re-enter the ERA process if changing circumstances result in the affected property not meeting the Tier 1 exclusion criteria.**

Completed by: *(Typed/Printed Name)*
(Title)

(Date)

I believe that the information submitted is true, accurate, and complete, to the best of my knowledge.

(Typed/Printed Name of Person)

(Title of Person)

(Signature of Person)

(Date Signed)

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1 These definitions were taken from 30 TAC §350.4 and may have both ecological and human health applications.
For the purpose of this checklist, it is understood that only the ecological applications are of concern.

(c) Tier 2: screening-level ecological risk assessment. The person shall conduct a screening-level ecological risk assessment to scientifically eliminate COCs that do not pose an ecological risk and to develop PCLs for those COCs that do pose an unacceptable risk to selected ecological receptors. Effect levels and exposure factors from the literature are used as early input, but Tier 2 PCLs are not developed without consideration of realistic assumptions and available site-specific information. The screening-level ecological risk assessment should contain the three following widely-acknowledged phases of an ecological risk assessment: problem formulation, which establishes the goals, breadth, and focus of the assessment; analysis, which consists of the technical evaluation of data on both the exposure of the ecological receptor to a chemical stressor and the potential adverse effects; and risk characterization, where the likelihood of adverse effects occurring as a result of exposure to a chemical stressor is evaluated. In order to develop a screening-level ecological risk assessment which appropriately evaluates ecological risk, the person shall meet the minimum requirements listed in paragraphs (1) - (10) of this subsection. Additional information on these requirements, as well as case examples, are provided in the agency's ecological assessment guidance. The person shall:

(1) use affected property concentrations of non-bioaccumulative COCs to compare to established ecological benchmarks and/or use approved methodologies to develop benchmarks to determine potential effects and to eliminate COCs that do not pose unacceptable ecological risk (if all COCs are eliminated at this point, the ecological risk assessment process ends and the items listed in paragraphs (2) - (9) of this subsection are not required);

(2) identify communities (e.g., soil invertebrates, benthic invertebrates) and major feeding guilds (e.g., omnivorous mammals, piscivorous birds) and their representative species which are supported by habitats on the affected property for each complete or reasonably anticipated to be completed exposure pathway;

(3) develop a conceptual model which graphically depicts the movement of COCs through media to communities and the feeding guilds;

(4) discuss COC fate and transport and toxicological profiles;

(5) prepare a list of input data which includes values from the literature (e.g., exposure factors, intake equations that account for total exposure, no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL) values, references), any available site-specific data, and reasonably conservative exposure assumptions, and then calculate the total exposure to selected ecological receptors from each COC not eliminated according to paragraph (1) of this subsection and present these calculations in tables or spreadsheets;

(6) utilize an ecological hazard quotient methodology to compare exposures to the NOAELs in order to eliminate COCs that pose no unacceptable risk (i.e., NOAEL hazard quotient less than or equal to 1); however, when multiple members of a class of COCs are present which exert additive effects, it is also appropriate to utilize an ecological hazard index methodology (if all COCs are eliminated at this point, the ecological risk assessment process ends and the items listed in paragraphs (7) - (9) of this subsection are not required);

(7) justify the use of less conservative assumptions (e.g., a larger home range) to adjust the exposure and repeat the hazard quotient exercise in paragraph (6) of this subsection, once again eliminating COCs that pose no unacceptable risk based on comparisons to the NOAELs and adding another set of comparisons, this time to the LOAELs, for those COCs indicating a potential risk (i.e., NOAEL hazard quotient >1); however, when multiple members of a class of COCs are present which exert additive effects, it is also appropriate to utilize an ecological hazard index methodology (if all COCs are eliminated at this point, the ecological risk assessment process ends and the items listed in paragraphs (8) and (9) of this subsection are not required);

(8) develop an "uncertainty analysis" which discusses the major areas of uncertainty associated with the screening-level ecological risk assessment, including a justification for not developing PCLs for particular COCs/pathways, if appropriate (e.g., NOAEL hazard quotient > 1 > LOAEL hazard quotient, an evaluation of the likelihood of ecological risk, a discussion of the half-life of the COCs, etc.); however, when multiple members of a class of COCs are present which exert additive effects, it is also appropriate to utilize an ecological hazard index methodology (if all COCs are eliminated at this point, the ecological risk assessment process ends and the item listed in paragraph (9) of this subsection is not required);

(9) calculate medium-specific PCLs bounded by the NOAEL and the LOAEL used in paragraph (7) of this subsection for those COCs that are not eliminated as a result of the hazard quotient exercises or the uncertainty analysis; and

(10) make a recommendation for managing ecological risk at the affected property based on the final ecological PCLs, unless proceeding under Tier 3 (may be included as part of the affected property assessment report, self-implementation notice, or the response action plan).

(d) Tier 3: site-specific ecological risk assessment. When any of the Tier 2 PCLs, as described in subsection (c) of this section, are considered by the person to be inappropriate or not reflective of existing conditions at the affected property, or when otherwise elected, the person may conduct a site-specific ecological risk assessment. If the person elects to begin the ecological evaluation of the affected property by proceeding directly to a site-specific ecological risk assessment, applicable components of a Tier 2 screening-level ecological risk assessment shall be incorporated, including subsections (c)(2) - (4), (8), and (10) of this section and other requirements of subsection (c) of this section as determined appropriate

by the executive director. The purpose of the optional site-specific ecological risk assessment shall be to incorporate additional information obtained through the performance of site-specific studies designed to provide a more empirical evaluation of ecological risk at the affected property. The result of the site-specific ecological risk assessment will be the development of site-specific Tier 3 PCLs, a determination that there is no ecological risk, or a conclusion that ecological risk is not apparent based on site-specific information. Site-specific studies which may be conducted include but are not limited to:

(1) development of site-specific bioaccumulation factors through the collection and analysis of tissue samples from appropriate ecological receptors.

(2) performance of toxicological testing of the impacted media via exposure to an appropriate test species.

(3) comparison of site data (e.g., macroinvertebrate diversity surveys) to like data from a reference area.

(4) other studies designed to obtain a preponderance or "weight-of-evidence" to draw conclusions about ecological risk.

(e) Cross-media transfers of COCs. In situations where cross-media transfer of a COC from a source medium to a POE within an exposure medium must occur for the receptor to be exposed, then the person shall use the cross-media natural attenuation factor equations as shown in the figure in §350.75(b)(1) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) to calculate the PCL. In lieu of using the human health RBEL referenced in the figures, the person shall use the ecological PCL established under subsections (c) or (d) of this section.

(f) Ecological risk management options. After the ecological risk has been quantified and PCLs have been established as specified in subsections (c) or (d) of this section and it has been determined that the ecological PCL is the critical PCL, or is the only PCL, the person may either:

(1) take action to remove and/or decontaminate the impacted media and COCs as described in §350.32 of this title (relating to Remedy Standard A); or

(2) remove, decontaminate, and/or control the impacted media and COCs or, when after consultation with the Natural Resource Trustees, it is determined appropriate by the executive director, conduct an ecological services analysis in accordance with §350.33 of this title (relating to Remedy Standard B). The ecological services analysis considers the ecological risks and benefits of the potential response actions available under Remedy Standard B at the affected property and, as appropriate, factors in compensatory ecological restoration in lieu of or in addition to remediation as a means of managing residual ecological risk.

Adopted February 25, 2009 Effective March 19, 2009

§350.78. Determination of Critical Protective Concentration Levels.

(a) For each individual COC for which PCLs have been developed in response to §350.71(k) of this title (relating to General Requirements), the person shall establish the critical PCL. The critical PCL

is the lowest PCL for a particular environmental medium considering all the exposure pathways for which a PCL is developed in accordance with §350.75(i) of this title (relating to Tiered Human Health Protective Concentration Level Evaluation) and/or §350.77 of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels).

(b) If the critical groundwater PCL, or an attenuation action level developed in accordance with §350.33(f) of this title (relating to Remedy Standard B), is greater than the aqueous solubility limit for that COC, then the COC should be addressed as NAPL should any NAPLs be present.

(c) If the critical PCL for a COC established in subsection (a) of this section is less than the method quantitation limit as defined in §350.4 of this title (relating to Definitions and Acronyms) or background concentration for that COC as determined in accordance with §350.51(l) and (m) of this title (relating to Affected Property Assessment), then the greater of the method quantitation limit or background concentration is the critical PCL for that COC.

(d) As an additional requirement, the critical PCL and any attenuation action level must ensure that the explosive vapor provisions set forth in §350.31(c) of this title (relating to General Requirements for Remedy Standards) are met.

Adopted September 2, 1999 Effective September 23, 1999

§350.79. Comparison of Chemical of Concern Concentrations to Protective Concentration Levels.

The person shall follow the procedures of this subsection to determine if a response action under this chapter is necessary to protect human health and the environment, and if a response action is necessary, then to determine if the remedy standard is attained. If the person satisfactorily demonstrates that all reasonably available analytical technology (e.g., selected ion monitoring) has been used to show that the COC cannot be measured to the method quantitation limit due to sample specific interferences, then the person shall be allowed to determine attainment based on the sample detection limit. The person shall make these determinations using the procedures described in either paragraph (1) or (2) of this subsection.

(1) The person may make a direct comparison between individual measurements of COC concentrations within environmental media and the critical PCLs. If the concentrations of a COC within an environmental medium exceeds a critical PCL, then a response action is required.

(2) The person may determine if a response action is required by using appropriate statistical methods provided in subparagraphs (A) or (B) of this paragraph.

(A) In order to determine if the concentrations of the COC at an affected property exceed a critical PCL the person shall conduct a statistical test of the following set of hypotheses:

(i) the null hypothesis (H_o) is that the mean of the COC concentrations in the affected property is equal to or greater than the critical PCL;

(ii) the alternative hypothesis (H_a) is that the mean COC concentration is less than the critical PCL;

(iii) the test is performed at a Type I error rate of 5%; and

(iv) any statistical model used for testing this hypothesis set must be demonstrated to meet these performance standards.

(B) In order to determine if the concentration of a COC in an environmental medium at the affected property is greater than the COC concentration for background areas, the person will use a statistical test meeting the following performance standards:

(i) the null hypothesis (H_o), in conjunction with any supporting assumptions, is equivalent to the statement that the mean of the COC concentrations in the two areas are identical;

(ii) the alternative hypothesis (H_a), is equivalent to the statement that the mean of the COC concentrations at the affected property exceeds that population of background concentrations; and

(iii) the test is performed at a Type I error rate of 20% and the test must have a demonstrable power of 80% for an alternative hypothesis equivalent to a 100% difference in population means in the Student's "t" test. Alternative statistical methods for comparing affected property COC concentrations to background COC concentrations may be approved by the executive director.

Adopted February 21, 2007 Effective March 19, 2007