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June 28, 2016

Gladys Liehr, PhD
Office of District and Business Support
Division of Waste Management
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Update to the assumptions for the development of irrigation water screening levels (IWSLs)

Dear Dr. Liehr:

At your request, we have updated the assumptions for the derivation of groundwater cleanup target levels for organic chemicals that are protective of human health under an irrigation scenario (Irrigation Water Screening Levels; IWSLs) and provided a list of updated IWSLs. Methodology used for the calculation of these IWSLs was described in a letter to Ms. Ligia-Mora Applegate dated January 14, 2009. Since that time, exposure factors utilized in the equation have been updated by the USEPA. The updated exposure factors are described in detail below. The exposure models used to derive the updated IWSLs for the irrigation of lawns, ornamental beds, and produce are identical to those presented in our January 14, 2009 letter. Exposure models used to derive IWSLs for the irrigation of lawns and ornamental beds are shown in Figure 1 and models used to derive IWSLs for the irrigation of produce are shown in Figure 2. The majority of the exposure assumptions used in the derivation of the IWSLs have not changed (Table 1). Exposure assumptions that have changed include an updated root and shoot produce ingestion rate, body weight, child body surface area, and residential exposure duration (Table 2).

Adult and aggregate body weight, child body surface area, and residential exposure duration were updated using OSWER Directive 9200.1-120 (USEPA, 2014). Based on this directive, an updated residential exposure duration of 26 years was incorporated into the screening levels (6 as a child, and 20 as an adult). The updated USEPA adult body weight is 80 kg and the child body weight remains the same (15 kg). An aggregate body weight of 65 kg was calculated from these values using an exposure duration of 26 years (6 years at 15 kg and 20 years at 80 kg). The recommended USEPA child resident surface area for water of 6,378 cm^2 was also used in the equation (Table 2). A comparison between the 2009 and 2016 exposure factor assumptions is shown in Table 3. The homegrown produce root and shoot ingestion rates were updated using Tables 13-1 and 13-60 through 13-62 of the 2011 Exposure Factors Handbook (EFH; USEPA, 2011). To calculate the root produce ingestion rate, an age-weighted mean root produce consumption rate was calculated for ages 1-6 (child) and 1-

26 (aggregate resident) using Table 13-62 of the EFH. An age-weighted mean shoot produce consumption rate was also calculated for ages 1-6 (child) and 1-26 (aggregate resident) using Tables 13-1, 13-60, and 13-61 of the EFH. To calculate a total shoot ingestion rate, the age-weighted mean protected vegetable, mean exposed vegetable, and mean fruit consumption rates were summed. The recalculated homegrown produce ingestion rates are listed in Table 2.

In the irrigation scenario, receptors are exposed to contaminated groundwater outdoors while irrigating lawns, ornamental beds, and vegetable crops. From this scenario, separate criteria were developed based upon: 1) exposure for residents using contaminated water for lawn and ornamental bed irrigation, including exposure from recreational use of the lawn sprinklers by children; 2) exposure for landscape maintenance workers using contaminated water for the irrigation of lawns and ornamental beds at commercial facilities; and 3) exposure for residents who use contaminated water to grow fruit and vegetables for personal consumption. Updated IWSLs are included in the attached Tables.

As we have cautioned before, the model and assumptions used to calculate uptake into fruit and vegetables are particularly conservative and may substantially overestimate risk. As such, the principal value of the produce IWSLs is as protective screening values, and exceedances where fruit and vegetables are grown should merit follow up investigation including empirical measurement of contaminant levels in produce samples if possible.

Please let us know if you have any questions regarding these updates.

Sincerely,





Leah D. Stuchal, Ph.D.

Stephen M. Roberts, Ph.D.

References:

USEPA (2014) *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.* United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9200.1-120.

USEPA (2001) *Exposure Factors Handbook: 2011 Edition.* United States Environmental Protection Agency, National Center for Environmental Assessment, Office of Research and Development, Washington, DC.

Figure 1 – Dose Equations for the irrigation of lawns and ornamental beds

Residential scenario, carcinogens:

$$\text{Dose} = GW \times 10^{-3}\,\text{mg}/\mu\text{g} \times \left[\left(\frac{EF_i \times IR_o \times ED_{ag}}{BW_{ag} \times AT_c}\right) + \left(\frac{EF_i \times SA \times T_t \times K_p \times \left(1 - \frac{SE}{100}\right) \times 10^{-3}\,\text{L/cm}^3 \times ED_c}{BW_c \times AT_c}\right) + \left(\frac{EF_i \times IR_{iag} \times T_t \times V_w \times \frac{SE}{100} \times ED_{ag}}{BW_{ag} \times V_a \times AT_c}\right)\right]$$

Residential scenario, non-carcinogens:

$$\text{Dose} = GW \times 10^{-3}\,\text{mg}/\mu\text{g} \times \left[\left(\frac{EF_i \times IR_o \times ED_c}{AT_{nc} \times BW_c}\right) + \left(\frac{EF_i \times SA \times T_t \times K_p \times \left(1 - \frac{SE}{100}\right) \times 10^{-3}\,\text{L/cm}^3 \times ED_c}{AT_{nc} \times BW_c}\right) + \left(\frac{EF_i \times IR_{ic} \times T_t \times V_w \times \frac{SE}{100} \times ED_c}{AT_{nc} \times BW_c \times V_a}\right)\right]$$

For this scenario, residential exposure is based on the "aggregate resident", which is an individual that lives at the residence as a child, adolescent and young adult. Exposure to contaminants by inhalation and incidental ingestion is assumed to occur throughout this period. However, dermal exposure (from playing in the sprinklers) occurs only as a child.

Landscape maintenance worker scenario, carcinogens:

$$\text{Dose} = GW \times 10^{-3}\,\text{mg}/\mu\text{g} \times \left[\left(\frac{EF_i \times IR_o \times ED_w}{BW_w \times AT_c}\right) + \left(\frac{EF_i \times IR_w \times T_t \times V_w \times \frac{SE}{100} \times ED_w}{BW_w \times V_a \times AT_c}\right)\right]$$

Landscape maintenance worker scenario, non-carcinogens:

$$\text{Dose} = \text{GW} \times 10^{-3}\,\text{mg}/\mu\text{g} \times \left[\left(\frac{\text{EF}_\text{i} \times \text{IR}_\text{o} \times \text{ED}_\text{w}}{\text{AT}_\text{nc} \times \text{BW}_\text{w}} \right) + \left(\frac{\text{EF}_\text{i} \times \text{IR}_\text{w} \times \text{T}_\text{t} \times \text{V}_\text{w} \times \frac{\text{SE}}{100} \times \text{ED}_\text{w}}{\text{AT}_\text{nc} \times \text{BW}_\text{w} \times \text{V}_\text{a}} \right) \right]$$

This scenario corresponds to a landscape worker at a commercial facility. The worker is assumed to be an adult exposed through inhalation and incidental ingestion.

Figure 2 – Dose equations for homegrown produce

Carcinogens:

$$\text{Dose} = \text{GW} \times 10^{-3}\,\text{mg}/\mu\text{g} \times \left(\frac{\text{EF}_\text{v} \times \left[\left(\text{RCF} \times \text{Ir}_\text{r} \right) + \left(\text{SCF} \times \text{Ir}_\text{s} \right) \right] \times \left(1 - \frac{\text{SE}}{100} \right) \times \text{RD} \times \text{ED}_\text{ag}}{\text{AT}_\text{c} \times \text{BW}_\text{ag}} \right)$$

Non-carcinogens:

$$\text{Dose} = \text{GW} \times 10^{-3}\text{mg}/\mu\text{g} \times \left(\frac{\text{EF}_\text{v} \times \text{ED}_\text{c} \times \left[\left(\text{RCF} \times \text{Ir}_\text{rc} \right) + \left(\text{SCF} \times \text{Ir}_\text{sc} \right) \right] \times \left(1 - \frac{\text{SE}}{100} \right) \times \text{RD}}{\text{AT}_\text{nc} \times \text{BW}_\text{c}} \right)$$

Supporting Equations:

$$\text{SE} = \left[7.95 \times \ln(\text{H}) \right] + 68.17$$

$$\text{RCF} = 10^{0.77\log \text{K}_\text{ow} - 1.52} + 0.82$$

$$\text{SCF} = \left(10^{0.95\log \text{K}_\text{ow} - 2.05} + 0.82 \right) \left(0.784 \times 10^{-0.434(\log K_{ow} - 1.78)^2 / 2.44} \right)$$

Table 1 – Values used in the derivation of irrigation water screening levels

Abbreviation	Definition	Value
AT_c	Carcinogenic Averaging Time	25550 d
AT_{nc}	Non-carcinogenic Averaging Time	(365 x ED) d
CSF_d	Dermal Cancer Slope Factor	chemical-specific $(mg/kg\text{-}d)^{-1}$
CSF_i	Inhalation Cancer Slope Factor	chemical-specific $(mg/kg\text{-}d)^{-1}$
CSF_o	Oral Cancer Slope Factor	chemical-specific $(mg/kg\text{-}d)^{-1}$
ED_c	Child Exposure Duration	6 y
EF_i	Irrigation Exposure Frequency	52 d/y
EF_v	Vegetable Exposure Frequency	350 d/y
H	Dimensionless Henry's Law Constant	chemical-specific
IGCTL	Irrigation GCTL	(mg/L)
IR_{iag}	Aggregate Resident Inhalation Rate	1.04 m^3/h
IR_{ic}	Child Inhalation Rate	1.2 m^3/h
IR_o	Water Incidental Ingestion Rate	0.01 L/d
K_{oc}	Octanol-Carbon Partition coefficient	chemcial specific (L/kg)
K_{ow}	Octanol-Water Partition Coefficient	chemical-specific
K_p	Permeability Coefficient	chemical-specific (cm/h)
RCF	Root Concentration Factor	chemical-specific (L/kg)
RD	Rainfall Dilution	0.5
RfD_d	Dermal Reference Dose	chemical-specific (mg/kg-d)
RfD_i	Inhalation Reference Dose	chemical-specific (mg/kg-d)
RfD_o	Oral Reference Dose	chemical-specific (mg/kg-d)
SCF	Shoot Concentration Factor	chemical-specific (L/kg)
SE	Water-to-air Chemical Stripping Efficiency	chemical-specific
THI	Target Hazard Index	1
TR	Target Cancer Risk	1.00E-06
T_t	Irrigation Time	0.483 h/d
V_a	Volume of Air for Volatilization	31320 m^3
V_w	Volume of Water Used	1450 L

Table 2 – Updated values used in the derivation of irrigation water screening levels

Abbreviation	Definition	Value	Source
BW_a	Adult Body Weight	80 kg	USEPA, 2014
BW_{ag}	Aggregate Resident Body Weight	65 kg	Calculated
BW_c	Child Body Weight	15 kg	USEPA, 2014
ED_a	Adult Exposure duration	20 y	USEPA, 2014
ED_{ag}	Aggregate Resident Exposure Duration	26 y	USEPA, 2014
Ir_f	Aggregate Ingestion of Root Produce	0.0513 kg/d	USEPA, 2011
Ir_{rc}	Child Ingestion of Root Produce	0.0268 kg/d	USEPA, 2011
Ir_s	Aggregate Ingestion of Shoot Produce	0.2261 kg/d	USEPA, 2011
Ir_{sc}	Child Ingestion of Shoot Produce	0.1468 kg/d	USEPA, 2011
SA	Child Surface Area	6378 cm^2	USEPA, 2014

Table 3 – Comparison between 2009 and 2016 exposure factors

Abbreviation	2009 Value	2016 Value
BW_a	70 kg	80 kg
BW_{ag}	51.9 kg	65 kg
BW_c	15 kg	15 kg
ED_a	24 y	20 y
ED_{ag}	30 y	26 y
Ir_f	0.0354 kg/d	0.0513 kg/d
Ir_{rc}	0.0099 kg/d	0.0268 kg/d
Ir_s	0.2626 kg/d	0.2261 kg/d
Ir_{sc}	0.0604 kg/d	0.1468kg/d
SA	7023 cm^2	6378 cm^2

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Acenaphthene	83-32-9	20 *Primary Standard*	160	20 *Primary Standard*	-Liver	-yes
Acenaphthylene	208-96-8	110	1700	3.4	-Kidney	-yes
Acephate	30560-19-1	14000	18000	820	-Neurological	-yes
Acifluorfen, sodium [or Blazer]	62476-59-9	3500	4500	94	-Kidney -Mortality	-yes
Acrolein	107-02-8	74	360	440	-Mortality RfC=Nasal	
Acrylonitrile	107-13-1	150	210	9.2	-Blood RfC=Nasal - Reproductive	-yes
Alachlor	15972-60-8	2200	2800	3.5	-Blood	-yes
Aldicarb sulfone	1646-88-4	10000	56000	970	-Neurological	
Aldrin	309-00-2	0.1	5.8	#	-Liver	-yes
Allyl alcohol	107-18-6	11000	58000	2800	-Kidney -Liver RfC=Liver - Kidney	
Aluminum	7429-90-5	*	*	NA	-Neurological RfC=Neurological	
Ametryn	834-12-8	28000	510000	440	-Liver	
Anilazine [or Dyrene]	101-05-3	680	22000	7.5	-None Specified	
Anthracene	120-12-7	88000	*	3500	-None Specified	
Antimony	7440-36-0	1400	22000	NA	-Blood	

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Aroclor mixture [see PCBs]						
Arsenic	7440-38-2	63	100	NA	-Cardiovascular -Skin RfC=Neurological	-yes
Atrazine	1912-24-9	210	680	3 *Primary Standard*	-Body Weight -Cardiovascular	-yes
Azobenzene	103-33-3	72	1100	1.4		-yes
Barium (soluble salts)	7440-39-3	390000	*	NA	-Kidney RfC=Developmental	
Benomyl	17804-35-2	410000	*	6400	-Developmental	
Bensulide	741-58-2	19000	280000	67	-Body Weight -Neurological	
Bentazon	25057-89-0	180000	*	3200	-Blood	
Benzene	71-43-2	610	1500	39	-Blood RfC=Blood	-yes
Benzo(a)anthracene	56-55-3	1.1	200	#		-yes
Benzo(a)pyrene	50-32-8	17	22	#		-yes
Benzo(b)fluoranthene	205-99-2	170	220	#		-yes
Benzo(g,h,i)perylene	191-24-2	930	*	#	-Kidney	
Benzo(k)fluoranthene	207-08-9	1700	2200	#		-yes
Beryllium	7440-41-7	15	19	NA	-Gastrointestinal RfC=Respiratory	-yes

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
BHC, gamma- [see Hexachlorocyclohexane, gamma-]						
Bioallethrin	28434-00-6	5400	450000	#	-Liver	
Biphenyl, 1,1- [or Diphenyl]	92-52-4	730	5700	21	-Kidney RfC=Liver - Kidney	-yes
Bis(2-ethylhexyl)adipate	103-23-1	400 *Primary Standard*	130000	#	-Body Weight -Developmental -Liver - Reproductive	-yes
Bis(2-ethylhexyl)phthalate [or DEHP]	117-81-7	26	11000	#	-Liver	-yes
Blazer [see Acifluorfen, sodium]						
Bromacil	314-40-9	750000	*	13000	-Body Weight	
Bromate	15541-45-4	130	220	NA	-Kidney	-yes
Bromomethane [or Methyl bromide]	74-83-9	5300	27000	860	-Gastrointestinal RfC=Nasal	
Bromoxynil	1689-84-5	350	1500	2.1	-None Specified	-yes
Cadmium (water)	7440-43-9	740	28000	NA	-Kidney RfC=Kidney	-yes
Captafol	2425-06-1	290	1000	0.9	-Kidney Bladder	-yes
Captan	133-06-2	31000	68000	190	-Body Weight	-yes
Carbaryl [or Sevin]	63-25-2	450000	*	9600	-Kidney -Liver	
Carbofuran	1563-66-2	27000	280000	530	-Neurological -Reproductive	

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Carbon disulfide	75-15-0	330000	*	42000	-Developmental RfC=Neurological	
Carbon tetrachloride	56-23-5	590	1300	20	-Liver RfC=Liver	-yes
Carbophenothion [or Trithion]	786-19-6	68	7300	#	-Neurological	
Carboxin	5234-68-4	650000	*	13000	-Body Weight -Mortality	
CFC 113 [see Trichloro-1,2,2-trifluoroethane, 1,1,2-]						
Chloramben	133-90-4	98000	840000	2300	-Liver	
Chlordane (total)	57-74-9 (i)	13	260	#	-Liver RfC=Liver	-yes
Chlordecone [see Kepone]						
Chlorine	7782-50-5	4000 *Primary Standard*	4000 *Primary Standard*	87000	-None Specified RfC=Respiratory	
Chlorite (sodium salt) [or Sodium chlorite]	7758-19-2	240000	*	NA	-Developmental -Neurological	
Chloroacetic acid	79-11-8	18000	110000	1100	-Cardiovascular	
Chlorobenzene	108-90-7	29000	330000	2600	-Liver RfC=Kidney - Liver	
Chlorobenzilate	510-15-6	100	1400	#	-Body Weight nutrition	-yes
Chloroethane [see Ethyl chloride]						
Chloroform	67-66-3	760	900	70	-Liver	-yes

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Chloromethane [see Methyl chloride]						
Chromium (hexavalent)	18540-29-9	250	310	NA	-None Specified RfC=Respiratory, Nasal	-yes
Chromium (total)	7440-47-3	250	310	NA	-None Specified RfC=Respiratory, Nasal	-yes
Chromium (trivalent)	16065-83-1	640000	*	NA	-None Specified	
Chrysene	218-01-9	15000	18000	#		-yes
Copper	7440-50-8	420000	*	NA	-Gastrointestinal	
Cyanide, free	57-12-5	960	4800	1500	-Reproductive RfC=Thyroid	
D, 2,4- [see Dichlorophenoxy acetic acid, 2,4-]						
Dalapon	75-99-0	250000	*	10000	-Kidney	
DBCP, 1,2- [see Dibromo-3-chloropropane, 1,2-]						
DEHP [see Bis(2-ethylhexyl)phthalate]						
Demeton	8065-48-3	130	2200	1.6	-Eye -Neurological	
Diallate	2303-16-4	130	2600	1	-Body Weight	-yes
Diazinon	333-41-5	1800	39000	15	-Neurological	
Dibenz(a,h)anthracene	53-70-3	17	22	#		-yes

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Dibromo-3-chloropropane, 1,2- [or DBCP, 1,2-]	96-12-8	7.9	7.7	0.6	-Reproductive RfC=Reproductive	-yes
Dibromoethane, 1,2- [or EDB]	106-93-4	25	33	0.8	-Adrenals -Liver -Reproductive RfC=Nasal	-yes
Dicamba	1918-00-9	170000	*	3500	-Developmental	
Dichlorobenzene, 1,2-	95-50-1	90000	*	5500	-None Specified RfC=Body Weight	
Dichlorobenzene, 1,4-	106-46-7	1400	2300	81	-Kidney -Liver RfC=Liver	-yes
Dichloroethane, 1,1-	75-34-3	6700	9600	480	-Kidney RfC=Kidney	-yes
Dichloroethane, 1,2- [or EDC]	107-06-2	490	700	29	-Kidney RfC=Neurological	-yes
Dichloroethene, 1,1-	75-35-4	130000	930000	21000	-Liver RfC=Liver	
Dichloroethene, cis-1,2-	156-59-2	5300	40000	670	-Kidney	
Dichloroethene, trans-1,2-	156-60-5	53000	370000	6500	-Immunological	
Dichlorophenoxy acetic acid, 2,4- [or 2,4-D]	94-75-7	35000	560000	620	-Blood -Kidney -Liver	
Dichloroprop	120-36-5	71000	*	1100	-Kidney	
Dichloropropane, 1,2-	78-87-5	1000	1600	57	-Liver RfC=Nasal	-yes
Dichlorvos	62-73-7	340	540	5.5	-Neurological RfC=Neurological	-yes
Dicofol [or Kelthane]	115-32-2	440	22000	#	-Adrenals	

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Dieldrin	60-57-1	0.7	8.1	#	-Liver	-yes
Dimethrin	70-38-2	14000	*	#	-None Specified	
Dinoseb	88-85-7	1800	56000	26	-Developmental	
Dioxane, 1,4-	123-91-1	1100	1600	53	-Kidney -Liver RfC=Respiratory	-yes
Dioxins, as total 2,3,7,8-TCDD equivalents	1746-01-6	0.00003 *Primary Standard*	0.0007	#	-Developmental -Reproductive RfC= Liver - Lymph - Vascular - Resp.	-yes
Diphenyl [see Biphenyl, 1,1-]						
Diquat	85-00-7	23000	120000	3100	-Eye	
Dyrene [see Anilazine]						
EDB [see Dibromoethane, 1,2-]						
EDC [see Dichloroethane, 1,2-]						
Endothall	145-73-3	210000	*	3100	-Gastrointestinal	
Endrin	72-20-8	290	13000	#	-Liver RfC=None Specified	
Ethion	563-12-2	580	28000	#	-Neurological	
Ethoprop	13194-48-4	700	5600	6.3	-Neurological	-yes
Ethyl chloride [or Chloroethane]	75-00-3	*	*	*	RfC=Developmental	

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Ethylbenzene	100-41-4	1400	5500	62	-Kidney -Liver RfC=Developmental	-yes
Fluoranthene	206-44-0	4600	*	#	-Blood -Kidney -Liver	
Fluorene	86-73-7	15000	*	710	-Blood	
Fluoride	16984-48-8	480000	*	NA	-Teeth mottling - RFC=Bone	
Fonofos	944-22-9	2300	100000	39	-Liver -Neurological	
Furfural	98-01-1	25000	170000	1400	-Liver RfC=Nasal	
Glyphosate [or Roundup]	1071-83-6	*	*	140000	-Kidney	
Heptachlor	76-44-8	0.9	17	#	-Liver	-yes
Heptachlor epoxide	1024-57-3	1.9	12	#	-Liver	-yes
Hexachlorobenzene	118-74-1	1.8	38	#	-Liver	-yes
Hexachlorocyclohexane, gamma- [or Lindane or BHC, gamma-]	58-89-9	15	140	0.2 *Primary Standard*	-Kidney -Liver	-yes
Hexachlorocyclopentadiene	77-47-4	280	1400	#	-Gastrointestinal RfC=Nasal	
Indeno(1,2,3-cd)pyrene	193-39-5	170	220	#		-yes
Iron	7439-89-6	*	*	NA	-Gastrointestinal	
Kelthane [see Dicofol]						

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Kepone [or Chlordecone]	143-50-0	2.8	16	#	-Kidney	-yes
Lindane [see Hexachlorocyclohexane, gamma-]						
Manganese (water)	7439-96-5	170000	*	NA	-Neurological RfC=Neurological	
Mercury	7439-97-6	280	1500	76	RfC=Neurological	
Methoxychlor	72-43-5	3700	280000	#	-Developmental -Reproductive	
Methyl bromide [see Bromomethane]						
Methyl chloride [or Chloromethane]	74-87-3	4500	6100	430	RfC=Neurological	-yes
Methyl parathion [or Parathion, methyl]	298-00-0	1100	14000	14	-Blood -Neurological	
Methyl tert-butyl ether [or MTBE]	1634-04-4	37000	53000	2000	RfC=Eye - Kidney - Liver	-yes
Methylene chloride [or Dichloromethane]	75-09-2	40000	76000	1800	-Liver RfC=Liver	-yes
Methylnaphthalene, 1-	90-12-0	210	2400	6.9	-Respiratory	-yes
Methylnaphthalene, 2-	91-57-6	2100	99000	120	-Respiratory	
Metolachlor	51218-45-2	770000	*	6600	-Body Weight -Developmental	
Metribuzin	21087-64-9	190000	*	4500	-Body Weight -Kidney -Liver -Mortality	
Mevinphos	7786-34-7	2500	14000	140	-Neurological	

Irrigation Water Screening Levels

Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Mirex	2385-85-5	0.6	3.7	#	-Liver -Thyroid	-yes
MTBE [see Methyl tert-butyl ether]						
Naphthalene	91-20-3	560	590	3.2	-Body Weight RfC=Nasal	-yes
Nickel	7440-02-0	83000	*	NA	-Body Weight RfC=Respiratory	-yes
Nitrate	14797-55-8	*	*	NA	-Blood	
Nitrate+Nitrite	NOCAS	**	**	NA		
Nitrite	14797-65-0	800000	*	NA	-Blood	
Nonylphenol	25154-52-3	74	44000	#	-Kidney	
Norflurazon	27314-13-2	310000	*	4200	-Liver -Thyroid	
Oryzalin	19044-88-3	16000	20000	20	-Adrenals -Blood -Kidney -Liver	-yes
Oxadiazon	19666-30-9	5500	280000	#	-Liver	
Oxamyl	23135-22-0	260000	*	23000	-Body Weight	
Paraquat	1910-42-5	47000	250000	6400	-Respiratory	
Parathion	56-38-2	13000	340000	120	-Neurological	
Parathion, methyl [see Methyl parathion]						

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Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
PCBs [or Aroclor mixture] (water)	1336-36-3	1.7	210	#	-Eye -Immunological	-yes
PCE [see Tetrachloroethene]						
Pebulate	1114-71-2	6.2	*	1500	-Blood	
Pendimethalin	40487-42-1	11000	*	#	-Liver	
Pentachlorophenol	87-86-5	7.5	390	#	-Liver	-yes
Permethrin	52645-53-1	200	16000	#	-Liver	-yes
Phenanthrene	85-01-8	8000	*	340	-Kidney	
Phenol	108-95-2	*	*	62000	-Developmental RfC=Liver - Neurological	
Phorate	298-02-2	420	11000	5.1	-Neurological	
Phosmet	732-11-6	140000	*	1200	-Body Weight -Liver -Neurological	
Phosphine	7803-51-2	380	1900	740	-Body Weight RfC=Body Weight	
Picloram	1918-02-1	530000	*	11000	-Liver	
Profluralin	26399-36-0	3100	160000	#	-None Specified	
Pyrene	129-00-0	4.2	250	#	-Kidney	-yes
Pyridine	110-86-1	7300	56000	400	-Liver RfC=Odor Threshold	

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Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Resmethrin	10453-86-8	29	2800	#	-Reproductive	-yes
Ronnel	299-84-3	42000	*	#	-Liver	
Rotenone	83-79-4	16000	220000	60	-Developmental	
Roundup [see Glyphosate]						
Selenium	7782-49-2	40000	280000	NA	-Hair Loss -Neurological -Skin RfC=Hair Loss - Neurological - Skin	
Sevin [see Carbaryl]						
Silver	7440-22-4	9400	280000	NA	-Skin	
Silvex [see Trichlorophenoxy propionic acid]						
Simazine	122-34-9	510	1300	7	-Blood -Body Weight	-yes
Sodium chlorite [see Chlorite (sodium salt)]						
Strychnine	57-24-9	2800	17000	46	-Mortality	
Styrene	100-42-5	270000	*	20000	-Blood -Liver RfC=Neurological	
TCE [see Trichloroethene]						
Temephos	3383-96-8	18000	*	#	-None Specified	
Temik [see Aldicarb]						

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Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Terbacil	5902-51-2	90000	730000	2000	-Liver -Thyroid	
Terbufos	13071-79-9	24	970	0.3	-Neurological	
Terbutryn	886-50-0	1400	56000	23	-Blood	
Tetrachloroethene [or PCE]	127-18-4	11000	38000	310	-Neurological RfC=Neurological	-yes
Thallium	7440-28-0	80	560	NA	-Hair Loss	
Toluene	108-88-3	160000	*	13000	-Kidney RfC=Neurological	
Toxaphene	8001-35-2	6.7	130	#		-yes
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	*	*	*	-Neurological RfC=Body Weight	
Trichlorobenzene, 1,2,4-	120-82-1	300	2100	70 *Primary Standard*	-Adrenals RfC=Urinary Tract	-yes
Trichloroethane, 1,1,1- [or Methyl chloroform]	71-55-6	*	*	500000	-Body Weight RfC=Body Weight	
Trichloroethane, 1,1,2-	79-00-5	470	1200	33	-Liver RfC=Nasal	-yes
Trichloroethene [or TCE]	79-01-6	930	2100	38	-Cardiovascular -Developmental - Immunological RfC=Cardiovascular - Develop. - Immune	-yes
Trichlorophenoxy propionic acid, 2,4,5- [or Silvex]	93-72-1	14000	450000	170	-Liver	
Trithion [see Carbophenothion]						
Vinyl chloride	75-01-4	93	210	6.3	-Liver RfC=Liver	-yes

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Contaminants	CAS #s	Residential Criteria (ug/L)	Industrial Criteria (ug/L)	Produce Criteria (ug/L)	Non-Cancer Target Organs/Systems or Effects†	Carcinogen
Xylenes, total	1330-20-7	110000	800000	18000	-Body Weight -Mortality RfC=Neurological	
Zinc	7440-66-6	*	*	NA	-Blood	

† = These default Target Organ(s)/Systems or Effects are those reported to occur at the doses used to derive the reference dose. Non-default Target Organ(s)/Systems or Effects may be justified through a detailed toxicological analysis of the chemicals present at a specific site.

* = Contaminant is not a health concern for this exposure scenario.

** = Contaminant does not have toxicity values listed in the February 2005 "Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C."

*** = TRPH does not have toxicity values applicable for criteria development in water.

= These chemicals have a logKow > 4.5 and are highly unlikely to be taken up by plants from water. The produce scenario is not of concern for these chemicals.

NA = Not applicable. The Briggs plant uptake model utilized for this scenario is not applicable to inorganic chemicals.

None Specified = Target organ(s) not available at time of criteria development.

Note: Freshwater and marine surface waters, and groundwater at the point of discharge into surface water, shall pass acute and chronic toxicity bioassay tests: The user should consult the standard definitions for acute and chronic toxicity given in FAC 62-302.200(1) and FAC 62-302.200(4), respectively.