C

Appendix C Reference Standards and Data for Water

Table C.1. Reference standards for radionuclides in water

Parameter[a]	National primary drinking water standard[b]	DCS[c]
^{241}Am		740
^{214}Bi		1,000,000
^{109}Cd		42,000
^{143}Ce		210,000
^{60}Co		14,000
^{51}Cr		3,800,000
^{137}Cs		4,100
^{155}Eu		1,000,000
Alpha particles[d,e]	15	
Beta particles and photon emitters (mrem/year)[e]	4	
^{3}H Tritated Water		2,600,000
^{3}H Organic Bound Tritium		1,000,000
^{131}I		2,800
^{40}K		16,000
^{237}Np		1,400
^{234}Pa		300,000
^{238}Pu		430
$^{239/240}$Pu		400
^{226}Ra		280
^{228}Ra		73
^{226}Ra and ^{228}Ra combined[e]	5	
^{106}Ru		19,000
^{90}Sr		1,700
^{99}Tc		390,000
^{228}Th		830
^{230}Th		720
^{232}Th		620
^{234}Th		84,000
^{234}U		1,200

Table C.1. Reference standards for radionuclides in water (continued)

Parameter[a]	National primary drinking water standard[b]	DCS[c]
^{235}U		1,300
^{236}U		1,300
^{238}U		1,400
Uranium, total (ug/L)[e]	30	

[a] *Only the radionuclides included in the Oak Ridge Reservation monitoring programs are listed. Unless labeled otherwise, units are pCi/L.*

[b] *40 Code of Federal Regulations Part 141, National Primary Drinking Water Regulations, Subparts B and G. The drinking water standards are presented strictly for reference purposes and have regulatory applicability only for public water supplies.*

[c] *DOE. "Derived Concentration Technical Standard," DOE-STD-1196-2022, December 2022.*

[d] *Including ^{226}Ra and excluding radon and uranium.*

[e] *Carcinogenic pollutant (EPA uses a 10^{-6} level to determine an increased risk of cancer)*

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
Acenaphthene				670, 990
Acrolein		3.0	3.0	6, 9
Acrylonitrile (c)				0.51, 2.5
Alachlor	2 (E1, T)			
Aldicarb[c]	3 (E1)			
Aldicarb sulfone[c]	2 (E1)			
Aldicarb sulfoxide[c]	4 (E1)			
Aldrin (c)		3.0	–	0.00049, 0.00050
Aluminum	50 to 200 (E2)			
Anthracene				8,300, 40,000
Antimony	6 (E1, T)			5.6, 640
Arsenic (c)	10 (E1, T)			10.0, 10.0
Arsenic(III)		340[d]	150[d]	
Asbestos	7 million fibers/L (MFL) (E1)			
Atrazine	3 (E1, T)			
Barium	2,000 (E1, T)			
Benzene (c)	5 (E1, T)			22, 510
Benzidine (c)				0.00086, 0.0020
Benzo(a)anthracene (c)				0.038, 0.18
Benzo(a)pyrene (PAHs) (c)	0.2 (E1, T)			0.038, 0.18
Benzo(b)fluoranthene (c)				0.038, 0.18
Benzo(k)fluoranthene (c)				0.038, 0.18
Beryllium	4 (E1, T)			
a-BHC (c)				0.026, 0.049
b-BHC (c)				0.091, 0.17

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L) (continued)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
g-BHC (Lindane) (b)	0.2 (E1, T)	0.95	–	0.98, 1.8
Bis(2-chloroethyl) ether (c)				0.30, 5.3
Bis(2-chloro-isopropyl) ether				1,400, 65,000
Bis(2-ethylhexyl) phthalate (Di (2-ethylhexyl) phthalate) (c)	6 (E1, T)			12, 22
Bis (Chloromethyl) ether (c)				0.0010, 0.0029
Bromate	10 (E1)			
Bromoform (c)				43, 1,400
Butyl Benzyl Phthalate (BBP) (c)				1,500, 1,900
Cadmium	5 (E1, T)	1.8[e]	0.72[e]	
Carbaryl		2.1	2.1	
Carbofuran	40 (E1, T)			
Carbon tetrachloride (c)	5 (E1, T)			2.3, 16
Chlordane (b) (c)	2 (E1, T)	2.4	0.0043	0.0080, 0.0081
Chloride	250,000 (E2)			
Chlorine (TRC)	4,000 (E1)	19	11	
Chlorine dioxide (as Cl_2)	800 (E1)			
Chlorite	1,000 (E1)			
Chloramines (as Cl_2)	4,000 (E1)			
Chlorobenzene (Monochlorobenzene)	100 (E1, T)			130, 1,600
Chlorodibromomethane (Dibromochloromethane) (c)				4.0, 130
Chloroform (c)				57, 4,700
2-Chloronaphthalene				1,000, 1,600
2-Chlorophenol				81, 150
Chlorpyrifos		0.083	0.041	
Chromium (total)	100 (E1, T)			
Chromium(III)		570[e]	74[e]	
Chromium(VI)		16[d]	11[d]	
Chrysene (c)				0.038, 0.18
Coliforms	630/100 mL (geometric mean) (T); no more than 5% of samples per month can be positive for total coliforms (E1)	630/100 mL, *E. coli* (geometric mean); 2880/100 mL, maximum, *E. coli* (single sample) 630/100 mL, *E. coli* (geometric mean); 2880/100 mL, maximum, *E. coli* (single sample)		126/100 mL (geometric mean), *E. coli;* 487/100 mL, maximum lakes/ reservoirs/state scenic river/Exceptional Tennessee Water/ Outstanding Natural Resource Water, *E. coli;* 941/100 mL, maximum, other water bodies, *E. coli*

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L) (continued)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
Color	15 color units (E2)			
Copper	1,300 (E1 "Action Level") 1,000 (E2)	13[e]	9.0[e]	
Cyanide (as free cyanide)	200 (E1, T)	22[f]	5.2[f]	140, 140
2,4-D (Dichlorophenoxyacetic acid)	70 (E1, T)			
4,4'-DDD (b) (c)				0.0031, 0.0031
4,4'-DDE (b) (c)				0.0022, 0.0022
4,4'-DDT (b) (c)		1.1	0.001	0.0022, 0.0022
Dalapon	200 (E1, T)			
Demeton		–	0.1	
Diazinon		0.17	0.17	
Dibenz(a,h)anthracene (c)				0.038, 0.18
1,2-dibromo-3-chloropropane (DBCP) (c)	0.2 (E1, T)			
1,2-Dichlorobenzene (*ortho*-)	600 (E1, T)			420, 1,300
1,3-Dichlorobenzene (*meta*-)				320, 960
1,4-Dichlorobenzene (*para*-)	75 (E1, T)			63, 190
3,3-Dichlorobenzidine (c)				0.21, 0.28
Dichlorobromomethane (c)				5.5, 170
1,2-Dichloroethane (c)	5 (E1, T)			3.8, 370
1,1-Dichloroethylene	7 (E1, T)			330, 7,100
Cis-1,2-Dichloroethylene	70 (E1, T)			
trans 1,2-Dichloroethylene	100 (E1, T)			140, 10,000
2,4-Dichlorophenol				77, 290
1,2-Dichloropropane (c)	5 (E1, T)			5.0, 150
1,3-Dichloropropene (c)				3.4, 210
Dieldrin (b)(c)		0.24	0.056	0.00052, 0.00054
Diethyl phthalate				17,000, 44,000
Di (2-ethylhexyl) adipate	400 (E1, T)			
Dinoseb	7 (E1, T)			
Dimethyl phthalate				270,000, 1,100,000
Dimethylphenol				380, 850
Di-n-butyl phthalate				2,000, 4,500
Dinitrophenols (DNP)				69, 5,300
2,4-Dinitrotoluene (DNT) (c)				1.1, 34
Dioxin (2,3,7,8-TCDD) (b) (c)	3 E-5 (E1, T)			0.000001[g], 0.000001[g]
Diquat	20 (E1, T)			
1,2-Diphenylhydrazine (Hydrazobenzene) (c)				0.36, 2.0
a-Endosulfan		0.22	0.056	62, 89
b-Endosulfan		0.22	0.056	62, 89
Endosulfan sulfate				62, 89
Endothall	100 (E1, T)			

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L) (continued)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
Endrin	2 (E1, T)	0.086	0.036	0.059, 0.06
Endrin aldehyde				0.29, 0.30
Ethylbenzene	700 (E1)			530, 2,100
Ethylene dibromide (1,2-Dibromoethane, EDB)	0.05 (E1, T)			
Fluoranthene				130, 140
Fluorene				1,100, 5,300
Fluoride	4,000 (E1) 2,000 (E2)			
Foaming agents	500 (E2)			
Glyphosate	700 (E1, T)			
Guthion		–	0.01	
Haloacetic acids (HAA5) (c)	60 (E1)			
Heptachlor (c)	0.4 (E1, T)	0.52	0.0038	0.00079, 0.00079
Heptachlor epoxide (c)	0.2 (E1, T)	0.52	0.0038	0.00039, 0.00039
Hexachlorobenzene (b)(c)	1 (E1, T)			0.0028, 0.0029
Hexachlorobutadiene (b)(c)				4.4, 180
Hexachlorocyclohexane-Technical (HCH) (b)(c)				0.123, 0.414
Hexachlorocyclopentadiene	50 (E1, T)			40, 1,100
Hexachloroethane (c)				14, 33
Indeno(1,2,3-cd)Pyrene (c)				0.038, 0.18
Iron	300 (E2)			
Isophorone (c)				350, 9,600
Lead	5 (T) 15 (E1 "Action Level")	65[e]	2.5[e]	
Malathion		–	0.1	
Manganese	50 (E2)			
Mercury (b)	2 (T) 2 (E1 inorganic)	1.4[d]	0.77[d]	0.05, 0.051
Methoxychlor	40 (E1, T)	–	0.001	
Methyl bromide				47, 1,500
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-O-cresol, DNOC)				13, 280
Methylene chloride (Dichloromethane) (c)	5 (E1, T)			46, 5,900
Nickel	100 (T)	470[e]	52[e]	610, 4,600
Nitrate as N	10,000 (E1,T)			
Nitrite as N	1,000 (E1, T)			
Nitrobenzene				17, 690
Nitrosamines				0.0008, 1.24
N-Nitrosodibutylamine (NDBA) (c)				0.063, 2.2

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L) (continued)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
N-Nitrosodiethylamine (NDEA) (c)				0.008, 2.4
N-Nitrosopyrrolidine (NPYR) (c)				0.16, 340
N-Nitrosodimethylamine (NDMA) (c)				0.0069, 30
N-Nitrosodi-n-propylamine (c)				0.05, 5.1
N-Nitrosodiphenylamine (c)				33, 60
Nonylphenol		28.0	6.6	
Odor	3 Threshold Odor Numbers (E2)[h]			
Oxamyl (Vydate)	200 (E1, T)			
Parathion		0.065	0.013	
Pentachlorobenzene (b)				1.4, 1.5
Pentachlorophenol (c)	1 (E1, T)	19[i]	15[i]	2.7, 30
pH	6.5 to 8.5 units (E2) 6.0 to 9.0 units (T)	6.0 to 9.0 units for wadeable streams; 6.5 to 9.0 units for larger rivers, lakes, reservoirs, and wetlands		6.0 to 9.0 units
Phenol				10,000, 860,000
Picloram	500 (E1,T)			
Polychlorinated biphenyls (PCBs), total (b)(c)	0.5 (E1, T)	–	0.014	0.00064, 0.00064
Pyrene				830, 4,000
Selenium	50 (E1, T)			170, 4,200
Selenium (lentic)[j]		20	1.5[k]	
Selenium (lotic)[l]		20	3.1[k]	
Silver	100 (E2)	3.2[e]	–	
Simazine	4 (E1, T)			
Styrene	100 (E1, T)			
Sulfate	250,000 (E2)			
1,2,4,5-Tetrachlorobenzene (b)				0.97, 1.1
1,1,2,2-Tetrachloroethane (c)				1.7, 40
Tetrachloroethylene (Perchloroethylene, PCE) (c)	5 (E1, T)			6.9, 33
Thallium	2 (E1, T)			0.24, 0.47
Toluene	1,000 (E1, T)			1,300, 15,000
Total dissolved solids	500,000 (E2, T)			
Toxaphene (b)(c)	3 (E1, T)	0.73	0.0002	0.0028, 0.0028
Tributyltin (TBT)		0.46	0.072	
1,2,4-Trichlorobenzene (1,2,4-TCB)	70 (E1, T)			35, 70

Table C.2. TDEC and EPA nonradiological water quality standards and criteria (µg/L) (continued)

Chemical	TDEC and EPA drinking water standards[a]	TDEC fish and aquatic life criteria		TDEC recreation criteria water + organisms, organisms only[b]
		Maximum	Continuous	
1,1,1-Trichloroethane (Methyl Chloroform)	200 (E1, T)			
1,1,2-Trichloroethane (c)	5 (E1, T)			5.9, 160
Trichloroethylene (TCE) (c)	5 (E1, T)			25, 300
2,4,5-Trichlorophenol				1,800, 3,600
2,4,6-Trichlorophenol (c)				14, 24
2,4,5 Trichlorophenoxyprioponic acid (2,4,5-TP, Silvex)	50 (E1, T)			
Trihalomethanes (total) (THMs) (c)	80 (E1)			
Vinyl chloride (c)	2 (E1, T)			0.25, 24
Xylenes (total)	10,000 (E1, T)			
Zinc	5,000 (E2)	120[e]	120[e]	7,400, 26,000

[a] *E1 = EPA Primary Drinking Water Standards; E2 = EPA Secondary Drinking Water Standards; T = TDEC domestic water supply criteria.*

[b] *For each parameter, the first recreational criterion is for "water and organisms" and is applicable on the Oak Ridge Reservation (ORR) only to the Clinch River, because it is the only stream on ORR classified for both domestic water supply and for recreation. The second criterion is for "organisms only" and is applicable to the other streams on ORR. TDEC uses a 10^{-5} risk level for recreational criteria for all carcinogenic pollutants (designated as (c) under the "Chemical" column). Recreational criteria for noncarcinogenic chemicals are set using a 10^{-6} risk level. (Note: All federal recreational criteria are set at a 10^{-6} risk level.)*

[c] *Administrative stay of the effective date.*

[d] *Criteria are expressed as dissolved.*

[e] *Criteria are expressed as dissolved and are a function of total hardness (mg/L). Criteria displayed correspond to a total hardness of 100 mg/L.*

[f] *Criteria may be applied as free cyanide if Standard Methods 4500-CN, 4500-CN G, or OIA-1677 are used.*

[g] *Total dioxin in the sum of the concentrations of all dioxin and dibenzofuran isomers after multiplication by Toxic Equivalent Factors.*

[h] *Threshold Odor Numbers (TON) are whole numbers that indicate how many dilutions it takes to produce odor-free water.*

[i] *Criteria are expressed as a function of pH; values shown correspond to a pH of 7.8.*

[i] *Lentic – Still water aquatic ecosystems such as ponds, lakes, or reservoirs.*

[k] *The numeric water criteria are applicable for all purposes, but for water quality assessment, fish tissue values may be used to confirm or refute impacts to aquatic life in accordance with and using values from EPA's Final Criterion: Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater (June 30, 2016).*

[l] *Lotic – Flowing water aquatic ecosystems such as streams and rivers.*

Acronyms and other definitions:

EPA = US Environmental Protection Agency

TDEC = Tennessee Department of Environment and Conservation

(b) = bioaccumuative parameter (TDEC)

(c) = carcinogenic pollutant (TDEC uses a 10^{-5} risk level and EPA uses a 10^{-6} level to determine an increased risk of cancer)