

## **Appendix D: Reference Standards and Data for Water**



Table D.1. Reference standards for radionuclides in water (pCi/L)

Parameter <sup>a</sup>	National primary drinking water standard <sup>b</sup>	4% of DCG <sup>c</sup>	DCG <sup>d</sup>
<sup>241</sup> Am		1.2	30
<sup>214</sup> Bi		24,000	600,000
<sup>109</sup> Cd		400	10,000
<sup>143</sup> Ce		1,200	30,000
<sup>60</sup> Co		200	5,000
<sup>51</sup> Cr		40,000	1,000,000
<sup>137</sup> Cs		120	3,000
<sup>155</sup> Eu		4,000	100,000
Gross alpha <sup>e</sup>	15		
Gross beta (mrem/yr)	4		
<sup>3</sup> H	20,000 <sup>f</sup>	80,000	2,000,000
<sup>131</sup> I		120	3,000
<sup>40</sup> K		280	7,000
<sup>237</sup> Np		1.2	30
<sup>234m</sup> Pa		2,800	70,000
<sup>238</sup> Pu		1.6	40
<sup>239/240</sup> Pu		1.2	30
<sup>226</sup> Ra	5 <sup>g</sup>	4	100
<sup>228</sup> Ra	5 <sup>g</sup>	4	100
<sup>106</sup> Ru		240	6,000
<sup>90</sup> Sr	8 <sup>f</sup>	40	1,000
<sup>99</sup> Tc		4,000	100,000
<sup>228</sup> Th		16	400
<sup>230</sup> Th		12	300
<sup>232</sup> Th		2	50
<sup>234</sup> Th		400	10,000
Thorium, natural		2	50
<sup>234</sup> U		20	500
<sup>235</sup> U		24	600
<sup>236</sup> U		20	500
<sup>238</sup> U		24	600
Uranium, natural		24	600
Uranium, total <sup>h</sup>		20	500

<sup>a</sup>Only the radionuclides sought on the Oak Ridge Reservation are listed.

<sup>b</sup>40 CFR Part 141 National Primary Drinking Water Regulations Subparts B and G.

<sup>c</sup>Four percent of the DCG represents the DOE criterion of 4 mrem effective dose equivalent from ingestion of drinking water.

<sup>d</sup>U.S. DOE Order 5400.5 Chapter III Derived Concentration Guides for Air and Water.

<sup>e</sup>Excludes radon and uranium.

<sup>f</sup>These values are not maximum containment levels (MCLs), but are concentrations that result in the effective dose equivalent (EDE) of the MCL for gross beta emissions, which is 4 mrem/year.

<sup>g</sup>Applies to combined <sup>226</sup>Ra and <sup>228</sup>Ra.

<sup>h</sup>Minimum of uranium isotopes.

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**Table D.2. Reference standards for chemicals and metals in water**

Parameter	National drinking water standards		Tennessee water quality criteria <sup>c</sup>			
	Primary <sup>a</sup>	Secondary <sup>b</sup>	Domestic water supply	Fish and aquatic life CMC	Recreation	
					Organisms	Water and organisms <sup>d</sup>
<i>Anions (mg/L)</i>						
Chloride		250				
Fluoride	4	2				
Nitrate	10					
Nitrite	1					
Sulfate, as SO <sub>4</sub>		250				
<i>Base/neutral/acid extractable organics (µg/L)</i>						
1,2-Dichlorobenzene ( <i>ortho</i> )	600		600		17,000	2,700
1,2,4-Trichlorobenzene	70		70			
1,3-Dichlorobenzene ( <i>meta</i> )					2,600	400
1,4-Dichlorobenzene ( <i>para</i> )	75		75		2,600	400
2,4-Dinitrophenol					14,000	70
2,4-Dinitrotoluene					91	1.1
2,4,6-Trichlorophenol					65	21
2-Methyl-4,6-Dinitrophenol					765	13.4
3,4-Benzo(b)fluoranthene					0.49	0.044
Benzo(k)fluoranthene					0.49	0.044
Acenaphthylene					2,700	1,200
Anthracene					110,000	9,600
Benzo(a)anthracene					0.49	0.044
Benzo(a)pyrene	0.2		0.2		0.49	0.044
bis-(2-chloroethyl)ether					14	0.31
bis-(2-ethylhexyl)phthalate	6	6			59	18
Di-n-butyl phthalate					12,000	2,700
Diethyl phthalate					120,000	23,000
Dimethyl phthalate					2,900,000	313,000
Fluoranthene					370	300
Fluorene					14,000	1,300
Hexachlorobenzene	1		1		0.0077	0.0075
Hexachlorocyclopentadiene	50		50		17,000	240
Hexachloroethane					89	19
Nitrobenzene					1,900	17
Pentachlorophenol (pH 7.8)	1		1	20	82	2.8
Pyrene					11,000	960
<i>Field measurements</i>						
Chlorine, mg/L				19		
Dissolved oxygen, mg/L				5		
Temperature, °C			30.5		30.5	30.5
Turbidity, JTU <sup>e</sup>	1					
pH, standard units		(6.5, 8.5)	(6.0, 9.0)	(6.5, 8.5)	(6.0, 9.0)	(6.0,9.0)

Table D.2 (continued)

Parameter	National drinking water standards		Tennessee water quality criteria <sup>c</sup>			
	Primary <sup>a</sup>	Secondary <sup>b</sup>	Domestic water supply	Fish and aquatic life	Recreation	
					Organisms	Water and organisms <sup>d</sup>
<i>Metals (mg/L)</i>						
Aluminum		0.05-0.2				
Antimony	0.006		0.006		4.30	0.014
Arsenic	0.05		0.05	360 (III)	0.0014	0.00018
Barium	2		2			
Beryllium	0.004		0.004			
Cadmium	0.005		0.005	0.0039 <sup>f</sup>		
Chromium, total	0.1		0.1			
Chromium (hexavalent)				0.016		
Copper	1.3 <sup>g</sup>	1		0.0177 <sup>f</sup>		
Iron		0.3				
Lead	0.015 <sup>g</sup>		0.005	0.0817 <sup>f</sup>		
Manganese		0.05				
Mercury	0.002		0.002	0.0024	0.00015	0.00014
Nickel			0.1	1.418 <sup>f</sup>	4.6	0.61
Selenium	0.05		0.050	0.02		
Silver		0.1		0.0041 <sup>f</sup>		
Thallium	0.002		0.002		0.0063	0.0017
Zinc		5		0.117 <sup>f</sup>		
<i>Others</i>						
Asbestos (fibers/L)	7,000,000					
Coliform bacteria <sup>h</sup>						
Color (color units)		15				
Cyanide (mg/L)	0.2		0.2	0.022	220	0.7
Odor (T.O.N.)		3				
Total dissolved solids (mg/L)		500	500			
<i>Pesticides/herbicides/PCBs (µg/L)</i>						
2,3,7,8-TCDD (Dioxin)	0.00003		0.00003		0.000001	0.000001
2,4-D	70		70			
2,4,5-TP (Silvex)	50		50			
4,4'-DDT				1.1	0.0059	0.0059
4,4'-DDE					0.0059	0.0059
4,4'-DDD					0.0084	0.0083
Alachlor	2		2			
Aldrin				3	0.0014	0.0013
Atrazine	3		3			
Carbofuran	40		40			
Chlordane	2		2	2.4	0.0059	0.0057
Dalapon	200		200			

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**Table D.2 (continued)**

Parameter	National drinking water standards		Tennessee water quality criteria <sup>c</sup>			
	Primary <sup>a</sup>	Secondary <sup>b</sup>	Domestic water supply	Fish and aquatic life	Recreation	
					Organisms	Water and organisms <sup>d</sup>
1,2-Dibromo-3-chloropropane	0.2		0.2			
Di(ethylhexyl)adipate	400		400			
Di(ethylhexyl)phthalate <sup>i</sup>						
Dinoseb	7		7			
Diquat	20		20			
a-Endosulfan				0.22	159	74
b-Endosulfan				0.22	159	74
Endothall	100		100			
Endrin	2		2	0.18	0.81	0.76
Ethylene dibromide	0.05		0.05			
Glyphosate	700		700			
Heptachlor	0.4		0.4	0.52	0.0021	0.0021
Heptachlor epoxide	0.2		0.2	0.52	0.0011	0.001
g-BHC (Lindane)	0.2		0.2	2	0.63	0.19
Methoxychlor	40		40			
Oxamyl (Vydate)	200		200			
PCB-1242					0.00045	0.00044
PCB-1254					0.00045	0.00044
PCB-1221					0.00045	0.00044
PCB-1232					0.00045	0.00044
PCB-1248					0.00045	0.00044
PCB-1260					0.00045	0.00044
PCB-1016					0.00045	0.00044
PCB, total	0.5		0.5		0.00045	0.00044
Picloram	500		500			
Simazine	4		4			
Toxaphene	3		3	0.73	0.0075	0.0073
<i>Volatile organics (µg/L)</i>						
1,1,1-Trichloroethane	200		200			
1,1-Dichloroethene	7		7		32	0.57
1,1,2-Trichloroethane	5		5		420	6
1,1,2,2-Tetrachloroethane					110	1.7
1,2-Dichloroethane	5		5		990	3.8
1,2-Dichloroethene <sup>j</sup>						
cis-1,2-Dichloroethene	70		70			
trans-1,2-Dichloroethene	100		100			700
1,2-Dichloropropane	5		5		39	0.52
cis-1,3-Dichloropropene					1,700	10
trans-1,3-Dichloropropene					1,700	10

Table D.2 (continued)

Parameter	National drinking water standards		Tennessee water quality criteria <sup>c</sup>			
	Primary <sup>a</sup>	Secondary <sup>b</sup>	Domestic water	Fish and aquatic life	Recreation	
					Organisms	Water and organisms <sup>d</sup>
Acrolein					780	320
Acrylonitrile					6.6	0.59
Benzene	5		5		710	12
Bromodichloromethane	100 <sup>k</sup>				220	2.7
Bromoform	100 <sup>k</sup>				3,600	43
Carbon tetrachloride	5		5		44	2.5
Chlorobenzene	100				21,000	680
Chloroform	100 <sup>k</sup>				4,700	57
Dibromochloromethane	100 <sup>k</sup>				340	4.1
Ethylbenzene	700		700		29,000	3,100
Methylene chloride (Dichloromethane)	5		5		16,000	47
Styrene	100		100			
Tetrachloroethene	5		5		88.5	8
Toluene	1,000		1,000		200,000	6,800
Trichloroethene	5		5		810	27
Trihalomethanes, total	100					
Vinyl chloride	2		2		5,250	20
Xylene, total	10,000		10,000			

<sup>a</sup>40 CFR Part 141—National Primary Drinking Water Regulations, Subparts B and G, as amended.

<sup>b</sup>40 CFR Part 143—National Secondary Drinking Water Regulations, as amended.

<sup>c</sup>Rules of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Chapter 1200-4-3, General Water Quality Criteria, as amended. CMC = criterion maximum concentration.

<sup>d</sup>These criteria, for the protection of public health, pertain to the consumption of water and organisms. They are applied only to waters designated for *both* recreation and domestic water supply.

<sup>e</sup>Jackson turbidity unit (JTU) and nephelometric turbidity unit (NTU) are roughly equivalent in the range of 25 to 1000 JTU.

<sup>f</sup>The standard is a function of total hardness. The values in this table correspond to a total-hardness value of 100 mg/L.

<sup>g</sup>“Action level” for initiation of corrosion control studies and treatment techniques, applicable to community water systems and non-transient, non-community water systems.

<sup>h</sup>Standard no longer numeric, but based on presence or absence in sample.

<sup>i</sup>See bis(2-ethylhexyl)phthalate.

<sup>j</sup>See *cis*-Dichloroethene and *trans*-Dichloroethene.

<sup>k</sup>Limit for total trihalomethanes (bromodichloromethane + bromoform + chloroform + dibromochloromethane).

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**Table D.3. 1999 surface water analyses at EMP surface water locations<sup>a</sup>**

Parameter	N det/ N total	Concentration				TWQC <sup>e</sup>
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	
<i>First Creek prior to confluence with Northwest Tributary (1STCK)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	9.7	6.7	8.2	1.5	<i>f</i>
pH (SU)	2/2	9.3	8.2	8.8	0.55	<i>f</i>
Temperature (°C)	2/2	20	16	18	2.1	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Gross alpha	2/2	38*	11*	25	14	<i>f</i>
Gross beta	2/2	620*	130*	380	250	<i>f</i>
H-3	1/2	360*	110	240	130	80,000
K-40	1/2	120*	-29	46	75	280
Total rad Sr	2/2	290*	59*	170	120	40
Total uranium	1/1	36*	36*	36	<i>f</i>	20
U-234	2/2	36*	7.7*	22	14	20
U-235	1/2	0.048	0*	0.024	0.024	24
U-238	2/2	0.52*	0.28*	0.40	0.12	24
<i>Bear Creek downstream from all possible DOE inputs (BCK 0.6)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	8.7	5.0	6.9	1.9	<i>f</i>
pH (SU)	2/2	8.4	7.8	8.1	0.30	<i>f</i>
Temperature (°C)	2/2	17	14	15	1.6	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/2	1.8*	0.0020	0.90	0.90	200
Gross alpha	2/2	8.6*	6.7*	7.7*	0.95	<i>f</i>
Gross beta	2/2	14*	6.6*	10	3.7	<i>f</i>
Total uranium	1/1	6.6*	6.6*	6.6	<i>f</i>	20
U-234	2/2	3.6*	2.1*	2.9	0.75	20
U-235	1/2	0.35*	0.059	0.20	0.15	24
U-238	2/2	8.0*	4.5*	6.3	1.8	24
<i>Clinch River downstream from all DOE inputs (CRK 16)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	9.6	4.9	7.1	0.48	<i>f</i>
pH (SU)	12/12	8.5	7.0	7.8	0.12	<i>f</i>
Temperature (°C)	12/12	23	7.0	16	1.6	<i>f</i>
<i>Metals (mg/L)</i>						
Aluminum, total	8/12	2.3	<0.20	~0.64	0.19	<i>f</i>
Barium, total	12/12	0.048	0.031	0.038	0.0014	<i>f</i>
Calcium, total	12/12	38	14	31	2.4	<i>f</i>
Iron, total	12/12	1.7	0.11	0.59	0.16	<i>f</i>
Magnesium, total	12/12	11	2.8	8.7	0.76	<i>f</i>
Manganese, total	12/12	0.21	0.028	0.073	0.014	<i>f</i>
Potassium, total	4/12	3.4	<2.0	~2.2	0.14	<i>f</i>
Sodium, total	12/12	6.2	1.1	4.8	0.49	<i>f</i>



Table D.3 (continued)

Parameter	N det/ N total	Concentration				
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	TWQC <sup>e</sup>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Cs-137	1/12	3.7*	-1.4	0.55	0.40	120
Gross alpha	4/12	5.0*	-0.35	0.85*	0.41	<i>f</i>
Gross beta	9/12	7.9*	0.23	3.4*	0.61	<i>f</i>
K-40	4/12	170*	-53	18	18	280
U-234	1/1	0.16*	0.16*	0.16	<i>f</i>	20
U-236	1/1	0*	0*	0	<i>f</i>	20
<i>Water supply intake for the K-25 Site (CRK 23)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	10	3.7	7.9	0.64	<i>f</i>
pH (SU)	12/12	9.7	7.3	8.1	0.20	<i>f</i>
Temperature (°C)	12/12	22	7.6	16	1.5	<i>f</i>
<i>Metals (mg/L)</i>						
Aluminum, total	5/12	0.61	<0.20	~0.27	0.043	<i>f</i>
Barium, total	12/12	0.041	0.031	0.035	0.00099	<i>f</i>
Calcium, total	12/12	39	23	34	1.2	<i>f</i>
Iron, total	12/12	0.74	0.084	0.26	0.053	<i>f</i>
Magnesium, total	12/12	11	4.7	9.7	0.47	<i>f</i>
Manganese, total	12/12	0.12	0.027	0.062	0.0092	<i>f</i>
Potassium, total	2/12	2.3	<2.0	~2.0	0.022	<i>f</i>
Sodium, total	12/12	6.8	1.7	5.5	0.38	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Be-7	1/12	28*	-13	4.1	3.2	40,000
Co-60	4/12	3.1*	-0.60	1.0*	0.32	200
Cs-137	1/12	1.9	-1.4	0.47	0.32	120
Gross alpha	4/12	2.3*	-0.19	0.55*	0.19	<i>f</i>
Gross beta	11/12	7.1*	0.32	3.7*	0.60	<i>f</i>
H-3	8/12	2,900*	-58	690*	260	80,000
K-40	1/12	190*	-66	-6.7	20	280
Total rad Sr	4/12	8.0	-0.56	2.4*	0.79	40
<i>Volatile organics (µg/L)</i>						
1,1,1-trichloroethane	1/12	U10	J2.0	~8.5	0.81	<i>f</i>
Toluene	1/12	U10	J1.0	~8.4	0.87	6,800
<i>Clinch River downstream from ORNL (CRK 32)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	11	2.3	7.6	0.74	<i>f</i>
pH (SU)	12/12	9.3	7.3	8.1	0.19	<i>f</i>
Temperature (°C)	12/12	21	7.9	15	1.4	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Be-7	1/12	15*	-7.9	5.3*	2.5	40,000
Co-60	4/12	2.2*	-0.32	0.94*	0.25	200
Cs-137	1/12	3.2*	-0.67	0.52	0.31	120

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**Table D.3 (continued)**

Parameter	N det/ N total	Concentration				
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	TWQC <sup>e</sup>
Gross alpha	2/12	1.7	0.0090	0.60*	0.13	<i>f</i>
Gross beta	11/12	8.0*	1.7*	3.6*	0.58	<i>f</i>
H-3	9/12	1,500*	21	500*	140	80,000
K-40	1/12	100*	-52	3.4	11	280
Total rad Sr	3/12	6.2*	-13	0.14	1.3	40
<i>Water supply intake for Knox County (CRK 58)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	13	5.8	8.4	0.58	<i>f</i>
pH (SU)	12/12	10	6.7	8.3	0.28	<i>f</i>
Temperature (°C)	12/12	26	8.3	17	1.9	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	3/12	2.7*	-0.55	0.84*	0.29	200
Cs-137	1/12	2.6*	-1.1	0.62*	0.30	120
Gross alpha	6/12	2.3*	-0.24	0.71*	0.19	<i>f</i>
Gross beta	11/12	8.4*	1.6*	3.8*	0.80	<i>f</i>
<i>Melton Hill Reservoir above City of Oak Ridge water intake (CRK 66)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	12	6.2	8.7	0.55	<i>f</i>
pH (SU)	12/12	9.9	7.2	8.3	0.24	<i>f</i>
Temperature (°C)	12/12	26	7.7	17	1.8	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/12	3.0*	-0.93	0.62*	0.33	200
Cs-137	1/12	2.1*	-2.2	-0.26	0.36	120
Gross alpha	4/12	1.0*	0	0.43*	0.095	<i>f</i>
Gross beta	5/12	3.9*	-0.015	1.8*	0.36	<i>f</i>
K-40	2/12	71*	-45	-5.3	9.5	280
<i>Clinch River (Solway Bridge) upstream from all DOE inputs (CRK 70)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	11	5.7	8.0	0.46	<i>f</i>
pH (SU)	12/12	9.3	7.1	8.0	0.21	<i>f</i>
Temperature (°C)	12/12	25	8.6	17	1.6	<i>f</i>
<i>Metals (mg/L)</i>						
Aluminum, total	1/12	0.59	<0.20	~0.23	0.033	<i>f</i>
Barium, total	12/12	0.039	0.031	0.035	0.00065	<i>f</i>
Calcium, total	12/12	39	28	35	0.89	<i>f</i>
Iron, total	12/12	0.52	0.072	0.20	0.032	<i>f</i>
Magnesium, total	12/12	11	8.0	10	0.24	<i>f</i>
Manganese, total	12/12	0.087	0.025	0.053	0.0047	<i>f</i>
Sodium, total	12/12	7.2	4.4	5.8	0.20	<i>f</i>
Zinc, total	1/12	0.053	<0.050	~0.050	0.00028	<i>f</i>

Table D.3 (continued)

Parameter	N det/ N total	Concentration				
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	TWQC <sup>e</sup>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Be-7	2/12	15*	-10	2.6	2.2	40,000
Co-60	2/12	1.8*	-3.5	0.39	0.42	200
Gross alpha	2/12	1.9*	-0.53	0.34	0.22	<i>f</i>
Gross beta	6/12	6.4*	-0.69	1.9*	0.49	<i>f</i>
H-3	2/12	320*	-130	48	34	80,000
Total rad Sr	2/12	4.3*	-5.8	-0.052	0.79	40
<i>East Fork Poplar Creek prior to entering Poplar Creek (EFK 0.1)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	7.0	5.4	6.2	0.80	<i>f</i>
pH (SU)	2/2	8.1	7.8	8.0	0.15	<i>f</i>
Temperature (°C)	2/2	17	16	17	0.25	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/2	1.4*	0.18	0.79	0.61	200
Cs-137	1/2	1.4*	-0.74	0.33	1.1	120
Gross alpha	2/2	3.6*	1.2*	2.4	1.2	<i>f</i>
Gross beta	2/2	5.2*	5.0*	5.1*	0.10	<i>f</i>
U-234	1/1	0.97*	0.97*	0.97	<i>f</i>	20
U-238	1/1	2.6*	2.6*	2.6	<i>f</i>	24
<i>East Fork Poplar Creek downstream from floodplain (EFK 5.4)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	7.3	6.0	6.7	0.65	<i>f</i>
pH (SU)	2/2	8.4	7.8	8.1	0.30	<i>f</i>
Temperature (°C)	2/2	17	16	16	0.50	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Cs-137	1/2	1.6*	0.30	0.95	0.65	120
Gross alpha	1/2	2.2*	0.64	1.4	0.78	<i>f</i>
Gross beta	2/2	42*	5.3*	24	18	<i>f</i>
K-40	1/2	37*	-4.7	16	21	280
<i>Fifth Creek just upstream of White Oak Creek at ORNL (FIFTHCK 0.1)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	9.7	6.7	8.2	1.5	<i>f</i>
pH (SU)	2/2	9.2	8.1	8.7	0.55	<i>f</i>
Temperature (°C)	2/2	19	15	17	1.8	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Gross alpha	2/2	2.0*	1.3*	1.7	0.35	<i>f</i>
Gross beta	2/2	34*	30*	32*	2.0	<i>f</i>
H-3	2/2	530*	430*	480*	50	80,000
Total rad Sr	2/2	15*	15*	15	0	40

**Oak Ridge Reservation**

**Table D.3 (continued)**

Parameter	N det/ N total	Concentration				TWQC <sup>e</sup>
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	
<i>Ish Creek prior to entering CRK 30.8 (ICK 0.7)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	8.9	6.2	7.6	1.4	<i>f</i>
pH (SU)	2/2	8.5	7.9	8.2	0.30	<i>f</i>
Temperature (°C)	2/2	14	13	13	0.80	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/2	3.2*	0.64	1.9	1.3	200
Gross alpha	1/2	1.6*	0.53	1.1	0.54	<i>f</i>
Gross beta	1/2	4.4*	0.36	2.4	2.0	<i>f</i>
<i>McCoy Branch prior to entering CRK 60.3 (MCCBK 1.8)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	9.6	4.8	7.2	2.4	<i>f</i>
pH (SU)	2/2	8.1	7.3	7.7	0.40	<i>f</i>
Temperature (°C)	2/2	18	11	15	3.5	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Gross alpha	2/2	1.1*	0*	0.55	0.55	<i>f</i>
Gross beta	1/2	2.8*	1.5	2.2	0.65	<i>f</i>
K-40	1/2	49	40*	45*	4.5	280
<i>Melton Branch downstream from ORNL (MEK 0.2)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	6/6	13	6.8	8.9	0.93	<i>f</i>
pH (SU)	6/6	8.2	7.0	7.5	0.21	<i>f</i>
Temperature (°C)	6/6	20	2.4	13	3.0	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	4/6	4.6*	-2.8	2.0	1.2	200
Cs-137	2/6	3.0*	0.0050	1.5*	0.47	120
Gross alpha	3/6	3.9*	0.44	1.6*	0.52	<i>f</i>
Gross beta <sup>h</sup>	6/6	14,000*	220*	2,900	2,200	<i>f</i>
Gross beta <sup>i</sup>	5/5	1,100*	220*	630*	160	<i>f</i>
H-3 <sup>h</sup>	6/6	1,400,000*	39,000*	610,000*	190,000	80,000
H-3 <sup>i</sup>	5/5	760,000*	39,000*	460,000*	130,000	80,000
K-40	1/6	89	-27	26	17	280
Total rad Sr <sup>h</sup>	6/6	5,700*	84*	1,200	910	40
Total rad Sr <sup>i</sup>	5/5	460*	84*	250*	65	40
Total uranium	2/2	0.97*	0.44*	0.71	0.27	20
U-234	3/3	0.52*	0.15*	0.33*	0.11	20
U-236	1/1	0*	0*	0	<i>f</i>	20
U-238	3/3	0.50*	0.15*	0.37*	0.11	24

Table D.3 (continued)

Parameter	N det/ N total	Concentration				TWQC <sup>e</sup>
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	
<i>Mitchell Branch upstream from the K-25 Site (MIK 1.4)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	4/4	10	5.6	7.6	0.94	<i>f</i>
pH (SU)	4/4	8.4	7.7	7.9	0.16	<i>f</i>
Temperature (°C)	4/4	20	8.4	13	2.6	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Gross alpha	1/4	0.92*	0.14	0.45*	0.18	<i>f</i>
Gross beta	2/4	2.8*	0.83	1.9*	0.42	<i>f</i>
<i>Northwest Tributary prior confluence with First Creek ORNL (NWTK 0.1)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	9.3	5.3	7.3	2.0	<i>f</i>
pH (SU)	2/2	9.3	8.1	8.7	0.60	<i>f</i>
Temperature (°C)	2/2	17	16	17	0.20	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Gross beta	2/2	160*	9.2*	85	75	<i>f</i>
H-3	1/2	160*	110	140	25	80,000
K-40	1/2	170*	19	95	76	280
Total rad Sr	1/2	71*	1.8	36	35	40
<i>Raccoon Creek sampling station prior to entering CRK 31 (RCK 2.0)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	2/2	7.0	4.0	5.5	1.5	<i>f</i>
pH (SU)	2/2	8.7	7.2	8.0	0.75	<i>f</i>
Temperature (°C)	2/2	13	12	13	0.80	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/2	1.8*	1.6	1.7*	0.10	200
Gross beta	2/2	90*	14*	52	38	<i>f</i>
H-3	2/2	330*	180*	260	75	80,000
Total rad Sr	2/2	43*	4.8*	24	19	40
<i>Walker Branch prior to entering CRK 53.4 (WBK 0.1)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	1/1	7.1	7.1	7.1	<i>f</i>	<i>f</i>
pH (SU)	1/1	7.5	7.5	7.5	<i>f</i>	<i>f</i>
Temperature (°C)	1/1	16	16	16	<i>f</i>	<i>f</i>
<i>White Oak Lake at White Oak Dam (WCK 1.0)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	12/12	14	4.8	7.0	0.72	<i>f</i>
pH (SU)	12/12	9.6	7.2	8.0	0.22	<i>f</i>
Temperature (°C)	12/12	27	3.8	17	2.1	<i>f</i>
<i>Metals (mg/L)</i>						
Aluminum, total	5/6	<2.0	0.34	~1.1	0.22	<i>f</i>
Barium, total	6/6	0.052	0.042	0.048	0.0014	<i>f</i>
Calcium, total	6/6	54	29	44	3.6	<i>f</i>

**Oak Ridge Reservation**
**Table D.3 (continued)**

Parameter	N det/ N total	Concentration				
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	TWQC <sup>e</sup>
Iron, total	6/6	1.3	0.51	0.91	0.13	<i>f</i>
Magnesium, total	6/6	13	4.7	10	1.2	<i>f</i>
Manganese, total	6/6	0.23	0.073	0.13	0.023	<i>f</i>
Potassium, total	5/6	<20	2.3	~5.7	2.9	<i>f</i>
Sodium, total	6/6	26	4.0	19	3.2	<i>f</i>
<i>PCBs</i>						
Aroclor-1254	1/12	U0.50	JB0.23	~0.48	0.022	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	8/12	3.9*	0.58	2.5*	0.32	200
Cs-137	12/12	40*	8.5*	22*	2.8	120
Gross alpha	12/12	21*	2.4*	6.7*	1.4	<i>f</i>
Gross beta	12/12	390*	140*	250*	22	<i>f</i>
H-3	12/12	140,000*	32,000*	71,000*	8,700	80,000
K-40	2/12	170*	-43	15	17	280
Total rad Sr	12/12	140*	54*	100*	7.6	40
Total uranium	5/5	9.3*	3.3*	5.6*	1.1	20
U-233/234	1/1	2.9*	2.9*	2.9	<i>f</i>	<i>f</i>
U-234	9/9	8.2*	1.6*	5.0*	0.66	20
U-235	1/10	0.065	0*	0.029*	0.0065	24
U-236	1/3	0.024	0*	0.015	0.0075	20
U-238	10/10	1.6*	0.41*	0.95*	0.12	24
<i>White Oak Creek downstream from ORNL (WCK 2.6)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	6/6	10	6.1	8.6	0.70	<i>f</i>
pH (SU)	6/6	8.1	6.8	7.4	0.20	<i>f</i>
Temperature (°C)	6/6	20	8.4	15	2.0	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Be-7	2/6	30*	-4.7	9.9	5.0	40,000
Co-60	1/6	1.5*	0.034	0.79*	0.31	200
Cs-137	6/6	67*	12*	37*	9.0	120
Gross alpha	5/6	7.4*	1.1	4.6*	1.1	<i>f</i>
Gross beta	6/6	870*	110*	270*	120	<i>f</i>
H-3	6/6	36,000*	3,300*	17,000*	4,900	80,000
Total rad Sr	6/6	330*	28*	100*	47	40
Total uranium	1/1	3.9*	3.9*	3.9	<i>f</i>	20
U-234	4/4	4.8*	1.2*	3.5*	0.82	20
U-235	2/4	0.075*	0*	0.024	0.017	24
U-236	1/1	0*	0*	0	<i>f</i>	20
U-238	4/4	2.1*	0.24*	0.98	0.42	24

Table D.3 (continued)

Parameter	N det/ N total	Concentration				TWQC <sup>e</sup>
		Max <sup>b</sup>	Min <sup>b</sup>	Avg <sup>c</sup>	Standard error <sup>d</sup>	
<i>White Oak Creek upstream from ORNL (WCK 6.8)</i>						
<i>Field measurements</i>						
Dissolved oxygen (ppm)	4/4	10	7.5	9.1	0.61	<i>f</i>
pH (SU)	4/4	8.5	6.7	7.5	0.37	<i>f</i>
Temperature (°C)	4/4	16	9.2	12	1.6	<i>f</i>
<i>Radionuclides (pCi/L)<sup>g</sup></i>						
Co-60	1/4	2.4*	0.45	1.0	0.46	200
Cs-137	1/4	1.8*	-0.45	0.88	0.48	120
Gross alpha	2/4	1.9*	-0.035	0.68	0.42	<i>f</i>
Gross beta	2/4	7.8*	-0.74	2.3	1.9	<i>f</i>
H-3	2/4	220*	39	130*	44	80,000
K-40	1/4	46*	-36	-5.3	18	280

<sup>a</sup>All values were included in the calculations. Only parameters that have one or more samples detected are listed in the table. The sampling and analysis plan contains a complete list of analyses performed.

<sup>b</sup>Prefix "<" indicates the value for a parameter (excluding organics) was not quantifiable at the analytical detection limit; "U" indicates the value for an organic parameter was undetected at the analytical detection limit; and "J" indicates the value was estimated at or below the analytical detection limit by the laboratory.

<sup>c</sup>A tilde (~) indicates that estimated values and/or detection limits were used in the calculation.

<sup>d</sup>Standard error of the mean.

<sup>e</sup>Tennessee General Water Quality Criteria for Recreation and Domestic Use, as amended (CRK 16, CRK 23, CRK 32, CRK 58, CRK 66, CRK 70) or Tennessee General Water Quality Criteria for Freshwater Fish and Aquatic Life, as amended (BCK 0.6, EFK 0.1, EFK 5.4, MEK 0.2, WCK 1.0, WCK 2.6, WCK 6.8). 4% of DOE DCG used for radionuclides, where applicable.

<sup>f</sup>Not applicable.

<sup>g</sup>Individual and average radionuclide concentrations significantly greater than zero are identified by an \*.

<sup>h</sup>The concentration of gross beta, total radioactive strontium, and tritium observed in May were significantly greater than corresponding values for 1998 and 1997 even when seasonal peaks are considered. Investigation into the event was inconclusive. A field duplicate taken during the event provided similar results; however, an environmental or natural cause for the high concentrations has not been identified. Results for samples collected about two weeks later at nearby Melton Branch locations for an EM activity did not reflect similar concentration elevations.

<sup>i</sup>Recalculated omitting the May results. See footnote *h*.