BRITISH COLUMBIA
Ministry of Environment

9

TECHNICAL GUIDANCE ON CONTAMINATED SITES

October 2005

Chlorophenol Aquatic Life Water Quality Standards

Schedule 6 of the Contaminated Sites Regulation provides aquatic life water quality standards for chlorophenols. These standards consist of a range of legally allowable concentrations at 20 °C for a pH range of 5.7–9.2, for all chlorophenol classes:

- monochlorophenols
- dichlorophenols
- trichlorophenols
- tetrachlorophenols
- pentachlorophenol

As noted in footnote 41 of the schedule, the standards vary with pH, temperature, and substance isomer.

This technical guidance document presents the advice of the Director of Waste Management and explains how to select applicable aquatic life water quality standards for these substances.

Dependence on pH, temperature, and isomer

Typically, chlorophenol aquatic toxicity increases with:

- increasing chlorination,
- increasing water temperature, and
- decreasing pH.

This has important implications for pollution prevention, because water temperature is subject to seasonal variation and pH can change from location to location.

The Schedule 6 *minimum* standard for each chlorophenol class was selected for the most toxic isomer within each class, a temperature of 20 °C, and a pH of 5.7–6.1. The *maximum* standard for each chlorophenol class is based on a temperature of 20 °C, the toxicity of the least toxic isomer within a class, and a pH of 9.2 or greater.

Under some circumstances, such as a temperature lower than 20°C, chlorophenol concentrations in excess of the maximums listed in Schedule 6 are acceptable.

Director's advice

The Schedule 6 chlorophenol aquatic life standards may be derived in two ways.

Option 1. Direct comparison with minimum Schedule 6 chlorophenol standards

At sites for which the aquatic life water quality standards apply, if the total concentration of a chlorophenol class does not exceed its minimum standard, then the site meets that standard.

Example:
Schedule 6 provides the following aquatic life standards for monochlorophenols: 8.5–650 ug/L.

Thus, at any site where the monochlorophenol aquatic life protective standards are applicable, the site is not considered a contaminated site if the total concentration of monochlorophenols present in water does not exceed 8.5 ug/L. The site would not require further remediation if it had already been cleaned up.

Note that since the Schedule 6 minimum standard represents the most conservative

combination of isomer, pH, and temperature variables, there is no need to measure concentrations of the specific chlorophenol isomers for that class or to determine the pH or temperature of the water.

Option 2. Comparison with temperature, pH and isomer-specific standards for chlorophenols

Where the concentrations of individual isomers within a chlorophenol class are known, as is the water pH and temperature, Tables 1–5 (attached) may be consulted to establish the appropriate chlorophenol aquatic life water quality standards for the site.

Note: If a person wishes to use the tables, concentrations of all listed chlorophenol isomers, water pH, and temperature must be measured at the site.

Since chlorophenol toxicity increases with temperature, ministry staff need to be assured that this parameter has been measured during at the warmest season of the year. Similar requirements pertain to the appropriate determination of water pH and chlorophenol isomer concentrations at the site, if they vary seasonally.

A Director of Waste Management may require additional characterization related to chlorophenol contamination. People seeking to use the attached tables for their site should contact the Director for further advice.

Example:
Groundwater adjacent a former wood treatment site contains 138 ug/L of 2,4,5-trichlorophenol. The summertime groundwater temperature was 8.0°C, and the pH was 6.8. The applicable standard is obtained from Table 2, which applies to temperatures of 5.0–9.5 °C. The fourth column from the left contains standards for a pH of 6.8, and the value for 2,4,5-trichorlophenol is 18 ug/L. The observed concentration of 138 ug/L exceeds the 18 ug/L standard.

For more information, contact the Environmental Management Branch at site@gov.bc.ca

Isomer, pH, and Temperature-Specific Tables for Contaminated Sites Aquatic Life Water Quality Standards for Chlorophenols

In accordance with the Contaminated Sites Regulation, Schedule 6, footnote 41, aquatic life protective water quality standards for chlorophenols can vary with pH, temperature, and substance isomer. Tables 1–5 constitute the advice of the Director of Waste Management regarding the appropriate aquatic life protective water quality standards to use for chlorophenols.

Notes:

1. The following tables may only be used if measured values of isomer concentrations, water pH, and temperature are known for the site.
2. Water temperature should be measured to the nearest 0.5 °C.
3. Water pH should be measured to the nearest 0.1 pH unit.
4. Chlorophenol isomer concentrations should be measured to the nearest 0.1 ug/L.

Table 1. Chlorophenol Isomer and pH Specific Aquatic Life Protective Water Quality Standards (ug/L) for Water Temperatures Within the Range 0–4.5 °C

Temperature 0–4.5 °C	pH							
Chlorophenol Isomer	<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
2-monochlorophenol	78	128	220	340	580	960	1580	2600
3-monochlorophenol	68	112	186	300	500	840	1400	2300
4-monochlorophenol	34	58	96	156	260	440	720	1180
2,3-dichlorophenol	22	36	62	102	166	280	460	760
2,4-dichlorophenol	12	20	32	52	86	144	240	400
2,5-dichlorophenol	10	16	28	46	74	124	200	340
2,6-dichlorophenol	40	66	110	182	300	500	820	1360
3,4-dichlorophenol	12	20	32	54	88	148	240	400
3,5-dichlorophenol	10	14	24	40	68	112	184	300
2,3,4-trichlorophenol	10	16	26	44	72	120	198	320
2,3,5-trichlorophenol	10	16	26	44	74	122	200	340
2,3,6-trichlorophenol	32	52	88	144	240	400	660	1080
2,4,5-trichlorophenol	10	14	24	40	66	112	184	300
2,4,6-trichlorophenol	24	38	64	106	176	300	480	800
3,4,5-trichlorophenol	4	6	10	18	28	48	78	128
2,3,4,5-tetrachlorophenol	8	12	20	34	56	94	156	260
2,3,4,6-tetrachlorophenol	22	36	58	98	160	260	440	720
2,3,5,6-tetrachlorophenol	10	16	26	44	72	122	200	340
2,3,4,5,6-pentachlorophenol	4	6	10	14	24	40	68	110

Table 2. Chlorophenol Isomer and pH Specific Aquatic Life Protective Water Quality Standards (ug/L) for Water Temperatures Within the Range 5.0–9.5 °C

Temperature 5.0–9.5 °C	pH							
Chlorophenol Isomer	<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2 –8.6	8.7–9.1	>9.1
2-monochlorophenol	58.5	96.0	165.0	255.0	435.0	720.0	1185.0	1950.0
3-monochlorophenol	51.0	84.0	139.5	225.0	375.0	630.0	1050.0	1725.0
4-monochlorophenol	25.5	43.5	72.0	117.0	195.0	330.0	540.0	885.0
2,3-dichlorophenol	16.5	27.0	46.5	76.5	124.5	210.0	345.0	570.0
2,4-dichlorophenol	9.0	15.0	24.0	39.0	64.5	108.0	180.0	300.0
2,5-dichlorophenol	7.5	12.0	21.0	34.5	55.5	93.0	150.0	255.0
2,6-dichlorophenol	30.0	49.5	82.5	136.5	225.0	375.0	615.0	1020.0
3,4-dichlorophenol	9.0	15.0	24.0	40.5	66.0	111.0	180.0	300.0
3,5-dichlorophenol	7.5	10.5	18.0	30.0	51.0	84.0	138.0	225.0
2,3,4-trichlorophenol	7.5	12.0	19.5	33.0	54.0	90.0	148.5	240.0
2,3,5-trichlorophenol	7.5	12.0	19.5	33.0	55.5	91.5	150.0	255.0
2,3,6-trichlorophenol	24.0	39.0	66.0	108.0	180.0	300.0	495.0	810.0
2,4,5-trichlorophenol	7.5	10.5	18.0	30.0	49.5	84.0	138.0	225.0
2,4,6-trichlorophenol	18.0	28.5	48.0	79.5	132.0	225.0	360.0	600.0
3,4,5-trichlorophenol	3.0	4.5	7.5	13.5	21.0	36.0	58.5	96.0
2,3,4,5-tetrachlorophenol	6.0	9.0	15.0	25.5	42.0	70.5	117.0	195.0
2,3,4,6-tetrachlorophenol	16.5	27.0	43.5	73.5	120.0	195.0	330.0	540.0
2,3,5,6-tetrachlorophenol	7.5	12.0	19.5	33.0	54.0	91.5	150.0	255.0
2,3,4,5,6-pentachlorophenol	3.0	4.5	7.5	10.5	18.0	30.0	51.0	82.5

Table 3. Chlorophenol isomer and pH specific aquatic life protective water quality standards (ug/L) for water temperatures within the range 10.0 to 14.5 °C .

Temperature 10.0 to 14.5 °C	pH							
Chlorophenol Isomer	<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
2-monochlorophenol	39	64	110	170	290	480	790	1300
3-monochlorophenol	34	56	93	150	250	420	700	1150
4-monochlorophenol	17	29	48	78	130	220	360	590
2,3-dichlorophenol	11	18	31	51	83	140	230	380
2,4-dichlorophenol	6	10	16	26	43	72	120	200
2,5-dichlorophenol	5	8	14	23	37	62	100	170
2,6-dichlorophenol	20	33	55	91	150	250	410	680
3,4-dichlorophenol	6	10	16	27	44	74	120	200
3,5-dichlorophenol	5	7	12	20	34	56	92	150
2,3,4-trichlorophenol	5	8	13	22	36	60	99	160
2,3,5-trichlorophenol	5	8	13	22	37	61	100	170
2,3,6-trichlorophenol	16	26	44	72	120	200	330	540
2,4,5-trichlorophenol	5	7	12	20	33	56	92	150
2,4,6-trichlorophenol	12	19	32	53	88	150	240	400
3,4,5-trichlorophenol	2	3	5	9	14	24	39	64
2,3,4,5-tetrachlorophenol	4	6	10	17	28	47	78	130
2,3,4,6-tetrachlorophenol	11	18	29	49	80	130	220	360
2,3,5,6-tetrachlorophenol	5	8	13	22	36	61	100	170
2,3,4,5,6-pentachlorophenol	2	3	5	7	12	20	34	55

Table 4. Chlorophenol isomer and pH specific aquatic life protective water quality standards (ug/L) for water temperatures within the range 15.0 to 19.5 °C.

Temperature 15.0 to 19.5 °C	pH							
Chlorophenol Isomer	<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
2-monochlorophenol	29.25	48	82.5	127.5	217.5	360	592.5	975
3-monochlorophenol	25.5	42	69.75	112.5	187.5	315	525	862.5
4-monochlorophenol	12.75	21.75	36	58.5	97.5	165	270	442.5
2,3-dichlorophenol	8.25	13.5	23.25	38.25	62.25	105	172.5	285
2,4-dichlorophenol	4.5	7.5	12	19.5	32.25	54	90	150
2,5-dichlorophenol	3.75	6	10.5	17.25	27.75	46.5	75	127.5
2,6-dichlorophenol	15	24.75	41.25	68.25	112.5	187.5	307.5	510
3,4-dichlorophenol	4.5	7.5	12	20.25	33	55.5	90	150
3,5-dichlorophenol	3.75	5.25	9	15	25.5	42	69	112.5
2,3,4-trichlorophenol	3.75	6	9.75	16.5	27	45	74.25	120
2,3,5-trichlorophenol	3.75	6	9.75	16.5	27.75	45.75	75	127.5
2,3,6-trichlorophenol	12	19.5	33	54	90	150	247.5	405
2,4,5-trichlorophenol	3.75	5.25	9	15	24.75	42	69	112.5
2,4,6-trichlorophenol	9	14.25	24	39.75	66	112.5	180	300
3,4,5-trichlorophenol	1.5	2.25	3.75	6.75	10.5	18	29.25	48
2,3,4,5-tetrachlorophenol	3	4.5	7.5	12.75	21	35.25	58.5	97.5
2,3,4,6-tetrachlorophenol	8.25	13.5	21.75	36.75	60	97.5	165	270
2,3,5,6-tetrachlorophenol	3.75	6	9.75	16.5	27	45.75	75	127.5
2,3,4,5,6-pentachlorophenol	1.5	2.25	3.75	5.25	9	15	25.5	41.25

Table 5. Chlorophenol isomer and pH specific aquatic life protective water quality standards (ug/L) for water temperatures within the range 20.0 to >20.0 °C.

Temperature 20.0 to >20.0 °C	pH							
Chlorophenol Isomer	**<6.2**	**6.2–6.6**	**6.7–7.1**	**7.2–7.6**	**7.7–8.1**	**8.2–8.6**	**8.7–9.1**	**>9.1**
2-monochlorophenol	19.5	32	55	85	145	240	395	650
3-monochlorophenol	17	28	46.5	75	125	210	350	575
4-monochlorophenol	8.5	14.5	24	39	65	110	180	295
2,3-dichlorophenol	5.5	9	15.5	25.5	41.5	70	115	190
2,4-dichlorophenol	3	5	8	13	21.5	36	60	100
2,5-dichlorophenol	2.5	4	7	11.5	18.5	31	50	85
2,6-dichlorophenol	10	16.5	27.5	45.5	75	125	205	340
3,4-dichlorophenol	3	5	8	13.5	22	37	60	100
3,5-dichlorophenol	2.5	3.5	6	10	17	28	46	75
2,3,4-trichlorophenol	2.5	4	6.5	11	18	30	49.5	80
2,3,5-trichlorophenol	2.5	4	6.5	11	18.5	30.5	50	85
2,3,6-trichlorophenol	8	13	22	36	60	100	165	270
2,4,5-trichlorophenol	2.5	3.5	6	10	16.5	28	46	75
2,4,6-trichlorophenol	6	9.5	16	26.5	44	75	120	200
3,4,5-trichlorophenol	1	1.5	2.5	4.5	7	12	19.5	32
2,3,4,5-tetrachlorophenol	2	3	5	8.5	14	23.5	39	65
2,3,4,6-tetrachlorophenol	5.5	9	14.5	24.5	40	65	110	180
2,3,5,6-tetrachlorophenol	2.5	4	6.5	11	18	30.5	50	85
2,3,4,5,6-pentachlorophenol	1	1.5	2.5	3.5	6	10	17	27.5