Fact Sheet Date: March 12, 1998

NEW YORK STATE
-AQUATIC FACT SHEET-

Ambient Water Quality Values for Protection of Aquatic Life

SUBSTANCE: Copper, dissolved **CAS REGISTRY NUMBER:** Not Applicable

TYPE:	BASIS:	FRESHWATER AMBIENT WATER QUALITY VALUE (ug/L):
Chronic	Propagation	$(0.96)e^{(0.8545[\ln \text{ppm hardness}] - 1.702)}$
Acute	Survival	$(0.96)e^{(0.9422[\ln \text{ppm hardness}] - 1.7)}$

INTRODUCTION

These values apply to the water column and are derived to protect aquatic life from the effects of waterborne contaminants. Values for the protection of propagation of aquatic life are referred to as Aquatic (Chronic) or A(C) values. Values for the protection of survival of aquatic life are referred to as Aquatic (Acute) or A(A) values.

SUMMARY OF INFORMATION AND DERIVATION OF VALUE

U.S. EPA (1995a,b) has derived acute and chronic aquatic life criteria for dissolved copper for the Great Lakes Water Quality Initiative (GLI). The Department has reviewed these criteria and determined that they are based on appropriate data and derived according to the scientific procedures in current and proposed 6 NYCRR Part 702. They are thus determined to be appropriate ambient water quality values for protection of aquatic life for New York State.

The attachment to this fact sheet provides U.S. EPA's derivation of the values expressed as total metal. Conversion to the dissolved form is made using the factor of 0.96 presented in U.S. EPA (1995a). U.S. EPA's Criterion Continuous Concentration (CCC) and Criterion Maximum Concentration (CMC) are equivalent to New York's Aquatic (Chronic) and Aquatic (Acute) values respectively.

REFERENCES

U.S. EPA (Environmental Protection Agency). 1995a. Final Water Quality Guidance for the Great Lakes System. 60 Federal Register: 15366 - 15425. March 23, 1995.

U.S. EPA (Environmental Protection Agency). 1995b. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Aquatic Life in Ambient Water. EPA-820-B-95-004. March 1995.

New York State Department of Environmental Conservation
Division of Water
SJS
January 14, 1997

ATTACHMENT

GREAT LAKES WATER QUALITY INITIATIVE

Tier 1 Aquatic Life Criterion for Copper

The new acceptable acute and chronic data for copper are given in Tables E1 and E2. These new data were used with those given in Tables 1 and 2 of the criteria document for copper (U.S. EPA 1985) to obtain the values given in Table E3. Because the toxicity of copper is hardness-dependent, all acute values in Table E3 have been adjusted to a hardness of 50 mg/L.

Criterion Maximum Concentration (CMC)

Data given in U.S. EPA (1985) for the species *Gammarus pulex* were not used because this species is not resident in North America. Several SMAVs given in Table E3 were derived from U.S. EPA (1985) by giving preference to results of "FT,M" tests.

The Final Acute Value (FAV) was calculated using the four lowest Genus Mean Acute Values in Table E3, resulting in an FAV of 14.57 ug/L at a hardness of 50 mg/L. This value did not need to be lowered to protect a commercially or recreationally important species of the Great Lakes System. The CMC was calculated by dividing the FAV by 2, resulting in a CMC of 7.285 ug/L, as total recoverable copper, at a hardness of 50 mg/L. The CMC was related to hardness using the slope of 0.9422 that was derived in U.S. EPA (1985):

$$CMC = e^{0.9422(\ln \text{hardness}) - 1.700}$$

Criterion Continuous Concentration (CCC)

Insufficient chronic toxicity data were available to calculate a Final Chronic Value (FCV) using the eight-family procedure. Sufficient chronic data were available to calculate a FCV by dividing the FAV by the Final Acute-Chronic Ratio (FACR). The new chronic test gave an ACR of 15.48 with the fathead minnow; the geometric mean of this value and the four ACRs for this species in U.S. EPA (1985) was 11.20. SMACRs were available for nine species (Table E3) and were higher for resistant species. To make the FACR appropriate for sensitive species, it was calculated from the two SMACRs that were determined with species whose SMAVs were close to the FAV. Thus the FACR was calculated as the geometric mean of 3.297 and 2.418 and was 2.823. The FCV = FAV/FACR = (14.57 ug/L)/(2.823) = 5.161 ug/L at a hardness of 50 mg/L. This value did not need to be lowered to protect a commercially or recreationally important species of the Great Lakes System. Thus the CCC was 5.161 ug/L, as total recoverable copper, at a hardness of 50 mg/L. The CCC was related to hardness using the slope of 0.8545 that was derived in U.S. EPA (1985):

$$CCC = e^{0.8545(\ln \text{hardness}) - 1.702}$$

The Criterion

The procedures described in the GLI Tier 1 methodology indicate that, except possibly where a locally important species is very sensitive, aquatic organisms should not be affected unacceptably if the four-day average concentration of copper does not exceed the numerical value (in ug/L) given by the equation

$$CCC = e^{0.8545(\ln \text{hardness}) - 1.702}$$

more than once every three years on the average and if the one-hour average concentration does not exceed the numerical value (in ug/L) given by the equation

$$CMC = e^{0.9422(\ln \text{hardness}) - 1.700}$$

more than once every three years on the average.

Table E1. New Acute Values for Copper

Species	Method*	Hardness (mg/L as $CaCO_3$)	Acute Value (ug/L)	Adjusted Acute Value (ug/L)**	Reference
Cladoceran, Ceriodaphnia reticulata	S,U	240	23	5.2	Elnabarawy et al. 1986
Cladoceran, Daphnia magna	S,U	240	41	9.4	Elnabarawy et al. 1986
Cladoceran, Daphnia pulex	S,U	240	31	7.1	Elnabarawy et al. 1986
Amphipod, Crangonyx pseudogracilis	S,U	50	1290	1290	Martin and Holdich 1986
Asiatic clam, Corbicula manilensis	FT,M	17	>2600	>7184	Harrison et al. 1984
Midge, Chironomus decorus	S,M	44	739	834	Kosalwat and Knight 1987
Fathead minnow, Pimephales promelas	FT,M	43.9	96	109	Spehar and Fiandt 1986
Bluegill, Lepomis macrochirus	S,M	31.2	340	530***	Bailey et al. 1985
Bluegill, Lepomis macrochirus	FT,M	31.2	550	858	Bailey et at. 1985
Rainbow trout, Oncorhynchus mykiss	FT,M	9.2	2.8	14	Cusimano and Brakke 1986
Striped bass, Morone saxatilis	S,U	285	270	52	Palawski et al. 1985

* S = static, FT = flow-through, U = unmeasured, M = measured.
** Adjusted to a hardness of 50 mg/L using the slope of 0.9422.
*** Not used in the calculation of the SMAV because data were available for this species from a "FT,M" test.

Table E2. New Chronic Values for Copper

Species	Method*	Acute Value (ug/L)	Chronic Value (ug/L)	Acute-Chronic Ratio	Reference
Fathead minnow, Pimephales promelas	ELS	96	6.2	15.48	Spehar and Fiandt 1986

* ELS = early life stage.

Table E3. Ranked Genus Mean Acute Values for Copper

Rank*	Genus Mean Acute Value (ug/L)**	Species	Species Mean Acute Value (ug/L)**	Species Mean Acute-Chronic Ratio
43	10240	Stonefly, Acroneuria lycorias	10240	-----
42	> 7184	Asiatic clam, Corbicula manilensis	> 7184	-----
41	6200	Caddisfly, Unidentified sp.	6200	-----
40	4600	Damselfly, Unidentified sp.	4600	-----
39	4305	American eel, Anguilla rostrata	4305	-----
38	1990	Crayfish, Procambarus clarkii	1990	-----
37	1877	Snail, Campeloma decisum	1877	156.2***
36	1397	Crayfish, Orconectes rusticus	1397	-----
35	1290	Amphipod, Crangonyx pseudogracilis	1290	-----
34	1057	Pumpkinseed, Lepomis gibbosus	640.9	-----
		Bluegill, Lepomis macrochirus	1742	37.96***
33	900	Snail, Amnicola sp.	900	-----
32	790.6	Banded killifish, Fundulus diaphanus	790.6	-----
31	684.3	Mozambique tilapia Tilapia mossambica	684.3	-----
30	331.8	Striped shiner, Notropis chrysocephalus	331.8	-----

Table E3. Ranked Genus Mean Acute Values for Copper

Rank*	Genus Mean Acute Value (ug/L)**	Species	Species Mean Acute Value (ug/L)**	Species Mean Acute-Chronic Ratio
29	289	Goldfish, Carassius auratus	289	-----

28	242.7	Worm, Lumbriculus variegatus	242.7	-----
27	196.1	Mosquitofish, Gambusia affinis	196.1	-----
26	170.2~	Midge, Chironomus tentans	197	-----
		Midge, Chironomus decorus	834	-----
		Midge, Chironomus sp.	30	-----
25	166.2	Snail, Goniobasis livescens	166.2	-----
24	156.8	Common carp, Cyprinus carpio	156.8	-----
23	141.2	Rainbow darter Etheostoma caeruleum	86.67	-----
		Orangethroat darter, Etheostoma spectabile	230.2	-----
22	135	Bryozoan, Pectinatella magnifica	135	-----
21	133	Chiselmouth, Acrocheilus alutaceus	133	-----
20	110.4	Brook trout, Salvelinus fontinalis	110.4	7.776***
19	109.9	Atlantic salmon, Salmo salar	109.9	-----
18	97.9	Bluntnose minnow, Pimephales notatus	72.16	26.36***

Table E3. Ranked Genus Mean Acute Values for Copper

Rank*	Genus Mean Acute Value (ug/L)**	Species	Species Mean Acute Value (ug/L)**	Species Mean Acute-Chronic Ratio
		Fathead minnow, Pimephales promelas	132.9	11.20***
17	90	Worm, Nais sp.	90	-----
16	86.67	Blacknose dace, Rhinichthys atratulus	86.67	-----
15	83.97	Creek chub, Semotilus atromaculatus	83.97	-----
14	83	Guppy,	83	-----

		Poecilia reticulata		
13	78.55	Central stoneroller, Campostoma anomalum	78.55	-----
12	73.99	Coho salmon, Oncorhynchus kisutch	87.1	-----
		Sockeye salmon, Oncorhynchus nerka	233.8	-----
		Cutthroat trout, Oncorhynchus clarki	66.26	-----
		Chinook salmon, Oncorhynchus tshawytscha	42.26	> 4.473***
		Rainbow trout, Oncorhynchus mykiss	38.89	-----
11	69.81	Brown bullhead, Ictalurus nebulosus	69.81	-----
10	56.21	Snail, Gyraulus circumstriatus	56.21	-----
9	53.08	Worm, Limnodrilus hoffmeisteri	53.08	-----
8	52~~	White perch, Morone americanus	5860	-----

Table E3. Ranked Genus Mean Acute Values for Copper

Rank*	Genus Mean Acute Value (ug/L)**	Species	Species Mean Acute Value (ug/L)**	Species Mean Acute-Chronic Ratio
		Striped bass, Morone saxatilis	52~~~	-----
7	39.33	Snail, Physa heterostropha	35.91	-----
		Snail, Physa integra	43.07	3.585***
6	37.05	Bryozoan, Lophopodella carteri	37.05	-----
5	37.05	Bryozoan, Plumatella emarginata	37.05	-----
4	22.09	Amphipod, Gammarus pseudolimnaeus	22.09	3.297
3	16.74	Northern squawfish, Ptychocheilus oregonensis	16.74	-----
2	14.48	Cladoceran, Daphnia magna	19.88	2.418

		Cladoceran, Daphnia pulex	16.5	-----
		Cladoceran, Daphnia pulicaria	9.263	-----
1	9.92	Cladoceran, Ceriodaphnia reticulata	9.92	-----

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* Ranked from most resistant to most sensitive based on Genus Mean Acute Value.
** At hardness = 50 mg/L.
*** Not used in the calculation of the Final Acute-Chronic Ratio.
~ This GMAV was not set equal to the lowest SMAV because the species was not identifed.

~~ This GMAV was set equal to the lower SMAV due to the large range in the SMAVs in this genus.
~~~ This SMAV was based on the results reported by Palawaki et al. (1985) because they were considered better data than those given in U.S. EPA (1985), although the data reported by Hughes (1973) supported the newer data.

At hardness = 50 mg/L:

FAV = 14.57 ug/L

CMC = FAV/2 = 7.285 ug/L

As a function of hardness:

$$CMC = e^{0.9422(\ln \text{hardness}) - 1.700}$$

FACR = 2.823

At hardness = 50 mg/L:

FCV = FAV/FACR = (14.57 ug/L)/(2.823) = 5.161 ug/L = CCC

As a function of hardness:

$$CCC = e^{0.8545(\ln \text{hardness}) - 1.702}$$
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References

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