DERIVATION OF ACUTE AND CHRONIC TOXICITY CRITERIA
FOR MERCURY
PREPARED BY: JIM SCHMIDT - WDNR
1997

EPA SPECIES MEAN ACUTE VALUES

(values from 10/80 EPA AWQC document, EPA 440/5-80-026 and 3/95 GLI Criteria Update, EPA-820-B-95-004)

Fathead minnow *(Pimephales promelas)*

VALUE (ug/L)	REFERENCE
168	Snarski & Olson, 1982
172	Spehar & FIandt, 1986
150	Call, et al. 1983
SMAV = 163.05	(3 results)

Cladoceran *(Daphnia magna)*

VALUE (ug/L)	REFERENCE
5	Biesinger & Christenson, 1972
3.177	Canton & Adema, 1978
1.488	Canton & Adema, 1978
2.18	Canton & Adema, 1978
4.4	Barera & Adams, 1983
4.4	Barera & Adams, 1983
9.6	Elnabarawy, et al. 1986
SMAV = 3.70	(7 results)

Cladoceran *(Daphnia pulex)*

VALUE (ug/L)	REFERENCE
2.217	Canton & Adema, 1978
3.8	Elnabarawy, et al. 1986
SMAV = 2.90	(2 results)

Mosquitofish *(Gambusia sp.)*

VALUE (ug/L)	REFERENCE
230	Paulose, 1988
180	Joshi & Rege, 1980
SMAV = 203.47	(2 results)

Guppy *(Poecilia sp.)*

VALUE (ug/L)	REFERENCE
30	Deshmukh & Marathe, 1980
26	Kangarot & Ray, 1987
SMAV = 27.93	(2 results)

Single-value species:

Species	Value (ug/L)	REFERENCE
Tubificid worm (*Branchiura sowerbyi)*	80	Chapman, et al. 1982
Tubificid worm (*Limnodrilus hoffmeisteri*)	180	Chapman, et al. 1982
Tubificid worm (*Quistadrilus multisetosus*)	250	Chapman, et al. 1982
Tubificid worm (*Rhyacodrilus montana*)	240	Chapman, et al. 1982
Tubificid worm (*Spirosperma ferox*)	330	Chapman, et al. 1982
Tubificid worm (*Spirosperma nikolskyi*)	500	Chapman, et al. 1982
Tubificid worm (*Stylodrilus heringianus*)	140	Chapman, et al. 1982
Tubificid worm (*Tubifex tubifex*)	140	Chapman, et al. 1982
Tubificid worm (*Varichaeta pacifica*)	100	Chapman, et al. 1982
Worm (*Nais* sp.)	1000	Rehwoldt, et al. 1973
Snail (*Amnicola* sp.)	80	Rehwoldt, et al. 1973
Snail (*Aplexa hypnorum*)	370	Rehwoldt, et al. 1973
Cladoceran (*Ceriodaphnia reticulata*)	2.9	Elnabarawy, et at. 1986
Amphipod (*Gammarus* sp.)	10	Rehwoldt, et al. 1973
Crayfish (*Faxonella clypeatus*)	20	Helt & FIngerman, 1977; Helt, 1981
Crayfish (*Orconectes limosus*)	50	Boutet & Chalsemartin, 1973)
Midge (*Chironomus riparius*)	750	Warnick & Bell, 1969
Mayfly (*Ephemerella subvaria*)	2000	Rossaro, et al. 1986
Caddisfly (unidentified species)	1200	Rehwoldt, et al. 1973
Damselfly (unidentified species)	1200	Rehwoldt, et al. 1973
Stonefly (*Acroneuria lycorias*)	2000	Warnick & Bell, 1969
Caddisfly (*Hydropsyche betteni*)	2000	Warrnck & Bell, 1969
Midge (*Chironomus* sp.)	20	Rehwoldt, et al. 1973
Coho salmon (*Onchorhynchus* sp.)	240	Lorz, et al. 1978
Rainbow trout FT,M (*Onchorhynchus* sp.)	275	Lock & van Overbeeke, 1981
Bluegill (*Lepomis macrochirus*)	160	Holcombe, et al. 1983
Tilapia (*Tilapia* sp.)	1000	Qureshi & Saksena, 1980
Walking catfish (*Clarias* sp.)	375	Kirubagaran & Joy, 1988
Amphipod (*Crangonyx pseudogracilis*)	1	Martin & Holdich, 1986 (see NOTE)

NOTE: EPA did not use this result in the criteria calculation because it was far below the 48-hr LC50. However, it is our opinion that it isn't clear which result is inaccurate, if either one is. Therefore, the 1 ug/L result was used, but also note that the wildlife criterion is several orders of magnitude lower than this, so the use of this number isn't terribly crucial.

MINIMUM DATABASE REQUIREMENT EVALUATION

According to s. NR 105.05(1)(a), acute toxicity criteria can be calculated if data are available on one or more species of freshwater animal in at least 8 different families, provided that of the 8 species:

1. At least one is a salmonid fish in the family Salmonidae in the class Osteichthyes,
2. At least one is a non-salmonid fish from another family in the class Osteichthyes, preferably a commercially or recreationally important species,
3. At least one is a planktonic crustacean (e.g., cladoceran, copepod),
4. At least one is a benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish),
5. At least one is an insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge),
6. At least one is a fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions,
7. At least one is an organism from a family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca), and
8. At least one is an organism from a family in any order of insect or any other phylum not already represented in subds. 1. to 7.

Using the above numbering scheme, the following species are represented in the minimum database requirements for criteria calculation. If any of the 8 categories are not represented in the database, a criterion cannot be calculated under ch. NR 105. Instead, a secondary value must be calculated.

1. Rainbow trout
2. Bluegill
3. Cladoceran *(D. pulex)*
4. Amphipod (*Gammarus* sp.)
5. Midge *(C. riparius)*
6. Fathead minnow, family Cyprinidae
7. Tubificid worms
8. Tilapia

CONCLUSION: An acute toxicity criterion can be calculated for mercury according to ch. NR 105.

GENUS NAME (w/ component species)		GMAV (ug/L)	CLASSIFICATIONS * CW	WW	LFF	LAL
Acroneuria		2000	x	x	x	x
Ephemerella		2000	x	x	x	x
Hydropsyche		2000	x	x	x	x
Damselfly un-id. sp.		1200	x	x	x	x
Caddisfly un-id. sp.		1200	x	x	x	x
Nais		1000	x	x	x	x
Tilapia		1000	#			
Spirosperma		406.20	x	x	x	x
S. nikolskyi	500					
S. ferox	330					
Clarias		375	#			
Aplexa		370	x	x	x	x
Onchorhynchus		256.90	x			
Coho salmon	240					
Rainbow trout	275					
Quistadrilus		250	x	x	x	x
Rhyacodrilus		240	x	x	x	x
Gambusia		203.47	#			
Limnodrilus		180	x	x	x	x
Pimephales		163.05	x	x	x	
Lepomis		160	x	x		
Stylodrilus		140	x	x	x	x
Tubifex		140	x	x	x	x
Varichaeta		100	x	x	x	x
Amnicola		80	x	x	x	x
Branchiura		80	x	x	x	x
Orconectes		50	x	x	x	x
Poecilia		27.93	#			
Chironomus		20 *	x	x	x	x
Faxonella		20	x	x	x	x
Gammarus		10	x	x	x	x
Daphnia		3.28	x	x	x	x
D. magna	3.70					
D. pulex	2.90					
Ceriodaphnia		2.9	x	x	x	x
Crangonyx		1.0	x	x	x	x

* - The two Chironomus species mean acute value varied by more than a factor of 10. Pursuant to EPA guidance, the lower of the two was used as the GMAV.

- Nonresident genus, only used for the coldwater classification in order to generate a result consistent with EPA.

TOTAL NUMBER OF GENERA REPRESENTED:	30	25	24	23

* - KEY TO CLASSIFICATIONS (an X is listed for species considered in each):

CW = Coldwater community, all genera are considered here.

WW = Warmwater sportfish community, only the coldwater fish are excluded from this database (also includes warmwater forage).

LFF = Limited forage fish community, all sport fish are excluded from this database.

LAL = Limited aquatic life, all fish are excluded from this database.

The four most sensitive genera in each classification are used to calculate the criteria under each classification, pursuant to s. NR 105.05 (2). From this point, the results of the calculation are shown using the variables listed in sub. (2).

CRITERION CALCULATION:

		CW
GMAV RANKS		
	4	10
	3	3.28
	2	2.9
	1	1.0
	n	30
ln GMAV		
	4	2.3025851
	3	1.1871006
	2	1.0647107
	1	0
(ln GMAV)^2		
	4	5.3018981
	3	1.4092078
	2	1.1336090
	1	0
P		
	4	0.1290323
	3	0.0967742
	2	0.0645161
	1	0.0322581
sq rt P		
	4	0.3592106
	3	0.3110855
	2	0.2540003
	1	0.1796053
EV		4.5543964
EW		7.8447149
EP		0.3225806
EPR		1.1039017

J	0.05
S	12.177683
L	-2.222142
A	0.5008707
FAV	1.6501574
ATC	0.8250787

CRITERIA:

calc. ATC	0.83

Since the most sensitive four genera in each classification are the same, the calculated criteria for WW< LFF, and LAL will be less than that for CW due to the smaller databases. Essentially, this means that there is no relief available for the criteria in these other classifications. It was deemed appropriate to set the criteria equal to those for the coldwater databases rather than having more restrictive criteria applied to these "subset" classifications.

Acute toxicity criteria for mercury:
ATC = 0.83 ug/L (all classifications)

EPA SPECIES MEAN CHRONIC VALUES

(values from 10/80 EPA AWQC document, EPA 440/5-80-054 and 3/95 GLI Criteria Update, EPA-820-B-95-004)

Cladoceran *(Daphnia magna)*

VALUE (ug/L)	METHOD	REFERENCE
0.96		Biesinger & Christensen, 1972
1.287		Biesinger & Christensen, 1972
SMCV = 1.11		(2 results)

Fathead minnow *(Pimephales promelas)*

VALUE (ug/L)	METHOD	REFERENCE
0.26		Snarski & Olson, 1982
0.23		Call, et al. 1983
SMCV = 0.245		(2 results)

Mysid shrimp (saltwater species)

VALUE (ug/L)	METHOD	REFERENCE
1.131		Gentile, et al. 1982

EPA ACUTE-CHRONIC RATIOS:

Not enough data are available to permit the calculation of independent chronic toxicity criteria. Instead, acute-chronic ratios (ACRs) must be developed such that the chronic criterion equals the final acute value divided by the appropriate ACR. The following table summarizes the calculation procedure for the ACRs using the procedure in s. NR 105.06 (5).

SPECIES	ACUTE VALUE	CHRONIC VALUE	TEST ACR	SMACR
Daphnia magna	5	1.11	4.50	4.50
Fathead minnow	168	0.26	646	649
	150	0.23	652	
Mysid shrimp (saltwater)	3.5	1.131	3.09	3.09

The mysid ratio was used because there are no ratios available for coldwater or warmwater sport fish. Since *daphnia magna* and not fathead minnow are among the most acutely sensitive species and the mysid ACR is close to the *d. magna* ACR, the Final ACRs for each classification are as follows:

All classifications =Geo. mean of 4.50 and 3.09 = 3.73

Chronic toxicity criteria for mercury:
All classifications = 1.65 / 3.73 = 0.44 ug/L