**DERIVATION OF ACUTE AND CHRONIC TOXICITY CRITERIA**
**FOR GAMMA-BHC (LINDANE)**
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## EPA SPECIES MEAN ACUTE 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 *(Simocephalus serrulatus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 520 | Sanders & Cope, 1966 |
| 880 | Sanders & Cope, 1966 |
| SMAV = 676.46 | (2 results) |

**Stonefly *(Pternoarcys californicus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 4.5 | Mayer & Ellersieck, 1986 |
| 1 | Mayer & Ellersieck, 1986 |
| SMAV = 2.12 | (2 results) |

**Amphipod *(Gammarus lacustris)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 48 | Sanders, 1969 |
| 88 | Mayer & Ellersieck, 1986 |
| SMAV = 64.99 | (2 results) |

**Amphipod *(Gammarus fasciatus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 10 | Sanders, 1972 |
| 11 | Sanders, 1972 |
| SMAV = 10.49 | (2 results) |

**Lake trout *(Salvelinus namaycush)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 32 | Mayer & Ellersieck, 1986 |
| 24 | Mayer & Ellersieck, 1986 |
| SMAV = 27.71 | (2 results) |

**Rainbow trout FT values *(Onchorhynchus mykiss)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 22 | Tooby & Durbin, 1975 |
| 30 | Tooby & Durbin, 1975 |
| SMAV = 25.69 | (2 results) |

**Coho salmon *(Onchorhynchus kisutch)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 41 | Macek & McAllister, 1970 |
| 23 | Mayer & Ellersieck, 1986 |
| 50 | Katz, 1961 |
| SMAV = 36.13 | (3 results) |

**Brown trout *(Salmo trutta)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 2 | Macek & McAllister, 1970 |
| 24 | Mayer & Ellersieck, 1986 |
| 25 | Mayer & Ellersieck, 1986 |
| 22 | Mayer & Ellersieck, 1986 |
| SMAV = 12.75 | (4 results) |

**Goldfish *(Carassius auratus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 131 | Macek & McAllister, 1970 |
| 90 | Mayer & Ellersieck, 1986 |
| 105 | Mayer & Ellersieck, 1986 |
| 152 | Henderson, et al. 1959 |
| SMAV = 117.12 | (4 results) |

**Bluegill *(Lepomis macrochirus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 54 | Macek, et al. 1969 |
| 51 | Macek, et al. 1969 |
| 57 | Randall, et al. 1979 |
| 56 | Mayer & Ellersieck, 1986 |
| 37 | Macek, et al. 1969 |
| 68 | Macek & McAllister, 1970 |
| 77 | Henderson, et al. 1959 |
| SMAV = 55.89 | (7 results) |

**Fathead minnow *(Pimephales promelas)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 87 | Macek & McAllister, 1970 |
| 62 | Henderson, et al. 1959 |
| 56 | Henderson, et al. 1959 |
| 77 | Mayer & Ellersieck, 1986 |
| 67 | Mayer & Ellersieck, 1986 |
| 86 | Mayer & Ellersieck, 1986 |
| SMAV = 71.54 | (6 results) |

**Cladoceran *(Daphnia magna)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 485 | Macek, et al. 1986 |
| 516 | Randall, et al. 1979 |
| 1000 | Hermens, et al. 1984 |
| SMAV = 630.18 | (3 results) |

**Green sunfish *(Lepomis cyanellus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 70 | Mayer & Ellersieck, 1986 |
| 83 | Mayer & Ellersieck, 1986 |
| SMAV = 76.22 | (2 results) |

**Yellow perch *(Perca flavescens)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 68 | Macek & McAllister, 1970 |
| 23 | Mayer & Ellersieck, 1986 |
| SMAV = 39.55 | (2 results) |

**Channel catfish *(Ictalurus punctatus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 44 | Macek & McAllister, 1970 |
| 49 | Mayer & Ellersieck, 1986 |
| SMAV = 46.43 | ( results) |

Species with single results:

**Cladoceran *(Daphnia pulex)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 460 | Sanders & Cope, 1966 |

**Sowbug *(Asellus brevicadus)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 10 | Sanders, 1972 |

**Midge *(Chironomus tentans)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 207 | Macek, et al. 1976 |

**Brook trout** (***Salvelinus fontinalis)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 44.3 | Macek, et al. 1976 |

**Chinook salmon *(Onchorhynchus tshawytscha)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 40 | Katz, 1961 |

**Carp (*Cyprinus carpio)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 90 | Macek & McAllister, 1970 |

**Black bullhead (*Ictalurus sp.)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 64 | Macek & McAllister, 1970 |

**Guppy *(Poecilia sp.)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 138 | Henderson, et al. 1959 |

**Redear sunfish *(Lepomis sp.)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 83 | Macek & McAllister, 1970 |

**Largemouth bass *(Micropterus salmoides)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 32 | Macek & McAllister, 1970 |

**Snail *(Lymnaea stagnalis)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 3.3 | Bluzat & Senge, 1979 |

**Damselfly *(Lestes congener)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 20 | Federle & Collins, 1976 |

**Backswimmer *(Notonecta undulata)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 3 | Federle & Collins, 1976 |

**Water beetle *(Peltodytes sp.)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 20 | Federle & Collins, 1976 |

**Fowlers toad *(Bufo woodhousei)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 3200 | Mayer & Ellersieck, 1986 |

**Western chorus frog (*Pseudacris sp.)***

| VALUE (ug/L) | REFERENCE |
|---|---|
| 2650 | Mayer & Ellersieck, 1986 |

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 (*G. fasciatus*)
5. Damselfly *(L. congener)*
6. Fathead minnow, family Cyprinidae
7. Sowbug, family Asellus
8. Channel catfish, family Ictaluridae

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

| GENUS NAME (w/ component species) | | GMAV (ug/L) | CLASSIFICATIONS * CW | WW | LFF | LAL |
|---|---|---|---|---|---|---|
| Asellus | | 10 | x | x | x | x |
| Bufo | | 3200 | x | x | x | x |
| Carassius | | 117.12 | x | x | x | |
| Chironomus | | 207 | x | x | x | x |
| Cyprinus | | 90 | x | x | x | |
| Daphnia | | 538.41 | x | x | x | x |
| D. pulex | 460 | | | | | |
| D. magna | 630.18 | | | | | |
| Gammarus | | 26.11 | x | x | x | x |
| G. fasciatus | 10.49 | | | | | |
| G. lacustris | 64.99 | | | | | |
| Ictalurus | | 54.51 | x | x | | |
| Ch. catfish | 46.43 | | | | | |
| Bl. Bullhead | 64 | | | | | |
| Lepomis | | 70.71 | x | x | | |
| Bluegill | 55.89 | | | | | |
| R. sunfish | 83 | | | | | |
| G. sunfish | 76.22 | | | | | |
| Lestes | | 20 | x | x | x | x |
| Lymnaea | | 3.3 | x | x | x | x |
| Micropterus | | 32 | x | x | | |
| Notonecta | | 3 | x | x | x | x |
| Onchorhynchus | | 33.36 | x | | | |
| Ch. salmon | 40 | | | | | |
| R. trout | 25.69 | | | | | |
| Co. salmon | 36.13 | | | | | |
| Peltodytes | | 20 | x | x | x | x |
| Perca | | 39.55 | x | x | | |
| Pimephales | | 71.54 | x | x | x | |
| Poecilia | | 138 | x | | | |
| Pseudacris | | 2650 | x | x | x | x |
| Pteronarcys | | 2.12 | x | x | x | x |
| Salmo | | 12.75 | x | | | |
| Salvelinus | | 35.04 | x | | | |
| B. trout | 44.3 | | | | | |
| L. trout | 27.71 | | | | | |
| Simocephalus | | 676.46 | x | x | x | x |
| TOTAL NUMBER OF GENERA REPRESENTED: | | | 23 | 19 | 15 | 12 |

* - 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** | **WW** | **LFF** | **LAL** |
|---|---|---|---|---|---|
| GMAV RANKS | | | | | |
| | 4 | 10 | 10 | 10 | 10 |
| | 3 | 3.3 | 3.3 | 3.3 | 3.3 |
| | 2 | 3 | 3 | 3 | 3 |
| | 1 | 2.12 | 2.12 | 2.12 | 2.12 |
| | n | 23 | 19 | 15 | 12 |
| ln GMAV | | | | | |
| | 4 | 2.3025851 | | | |
| | 3 | 1.1939225 | | | |
| | 2 | 1.0986123 | | | |
| | 1 | 0.7520387 | | | |
| (ln GMAV)^2 | | | | | |
| | 4 | 5.3018981 | | | |
| | 3 | 1.4254509 | | | |
| | 2 | 1.206949 | | | |
| | 1 | 0.5655622 | | | |
| P | | | | | |
| | 4 | 0.1666667 | | | |
| | 3 | 0.125 | | | |
| | 2 | 0.0833333 | | | |
| | 1 | 0.0416667 | | | |
| sq rt P | | | | | |
| | 4 | 0.4082483 | | | |
| | 3 | 0.3535534 | | | |
| | 2 | 0.2886751 | | | |
| | 1 | 0.2041241 | | | |
| EV | | 5.3471585 | | | |
| EW | | 8.4998601 | | | |
| EP | | 0.4166667 | | | |
| EPR | | 1.254601 | | | |
| | | | | | |
| J | | 0.05 | | | |
| S | | 7.6398556 | | | |
| L | | -1.059453 | | | |
| A | | 0.6488707 | | | |
| FAV | | 1.9133789 | | | |
| ATC | | 0.9566865 | | | |

CRITERIA:

| | **CW** |
|---|---|
| calc. ATC | 0.96 |

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 lindane:**
**ATC = 0.96 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 |
|---|---|---|
| 14.5 | | Macek, et al. 1976 |
| SMCV = 14.5 | | (1 result) |

**Midge *(Chironomus tentans)***

| VALUE (ug/L) | METHOD | REFERENCE |
|---|---|---|
| 3.3 | | Macek, et al. 1976 |
| SMCV = 0.22 | | (1 result) |

Since no fish chronic data are available, a chronic criterion cannot be calculated.