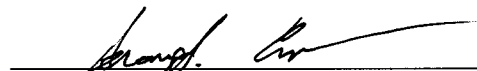


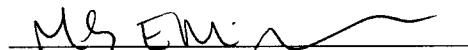
**Final Report**  
**C8 Assessment of Toxicity Team (CATT) Report Addendum**  
**Aquatic Life Advisory Concentration for C8**


October, 2002

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## 1.0 INTRODUCTION

This report provides an aquatic life advisory concentration for ammonium perfluorooctanoate (C8) based on available toxicity data from a literature search supplied by TERA. The method followed USEPA's 1985, *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* and USEPA's 1986, *Guidelines for Deriving Ambient Aquatic Life Advisory Concentrations*.

Currently, there is no water quality criterion, advisory concentration, or general standard for C8 that ensures the protection of aquatic organisms and their uses. The lack of required toxicity data does not allow the calculation of an ambient water quality criterion. Advisory concentrations "can be based on fewer data than can water quality criteria for aquatic life because advisory concentrations are not intended to have as much regulatory impact as ambient water quality criteria" (USEPA, 1986). Advisory concentrations are conservative estimates of potential effects levels below which "there is probably no cause for concern about effects on aquatic organisms and their uses" (USEPA, 1986).

## 2.0 REVIEW OF TOXICITY DATA

After reviewing the literature and toxicity data provided by USEPA, we summarized acute and chronic toxicity studies of C8 (Table 1). These data include acute toxicity of C8 to:

- *Daphnia magna* (a water flea);
- *Dunaliella salina* (a freshwater algae);
- *Lepomis macrochirus*, (bluegill sunfish);
- *Oncorhynchus mykiss* (rainbow trout);
- *Photobacterium phoshoreum* (a marine bacteria);
- *Pimephales promelas* (fathead minnow);
- *Selenestrum capricornutum* (a freshwater green algae);
- Snails; and,
- microbes.

Chronic toxicity values are available for *Daphnia magna* and *Pimephales promelas* (Table 2). Our review indicated that many of these studies met rejection criteria (shown on page one of Appendix A) or had invalid results.

Table 1 indicates which studies met the rejection criteria and the reason for rejection. Results of the rejected studies were not included in the final calculation of the advisory concentration.

## 3.0 CALCULATION OF AN ADVISORY ACUTE VALUE

The acceptable data (from among those studies that did not meet rejection criteria) do not include all taxa required to calculate an ambient water quality criteria. (Required taxa are listed on page one of Appendix A). Therefore, we followed the USEPA 1986 protocol, *Guidelines for Deriving Ambient Aquatic Life Advisory Concentrations*, which draws upon the procedures in *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms*

and *Their Uses* (USEPA, 1985). The methodology followed to derive the advisory concentration is shaded pink in Figure 1.

The estimate of an advisory concentration requires data from acceptable acute tests with at least three animal species. The recommended taxa are:

- one fish species in the class Osteichthyes;
- one invertebrate species in the class Crustacea; and
- one invertebrate species in the phylum Mollusca or a different family of the Arthropoda.

The available literature does not offer an invertebrate species in the phylum Mollusca or a species from a different family among the Arthropoda. Therefore, we used test results that:

- did not meet the rejection criteria (as explained in Table 1); and,
- were from the required taxa, although we did not have species from all the recommended taxa (these studies are highlighted in Table 1).

These results were from tests on three species in the class Osteichthyes and one in the class Crustacea:

- *Lepomis macrochirus* (bluegill sunfish);
- *Oncorhynchus mykiss* (rainbow trout);
- *Pimephales promelas* (fathead minnow); and,
- *Daphnia magna* (water flea).

Appropriate effect level values were selected from acute tests according to the criteria listed on page 2 of Appendix A. Species Mean Acute Values (SMAVs) were calculated as:

$$\text{SMAV} = \{n_i * n_{(i=1)} \dots n_{(i+x)}\}^{1/x}$$

Where:

n = acceptable acute value from a specific study;

x = number of studies available.

The specific SMAVs for the selected species are:

*Daphnia magna* (based on 48 hr EC50 and LC50 values)  
 $\text{SMAV} = (360*266*632*221)^{1/4} = 340.0740 \text{ mg/L}$

*Lepomis macrochirus* (based on 96 hr LC50 values)  
 $\text{SMAV} = (569*634*420)^{1/3} = 533.1101 \text{ mg/L}$

*Oncorhynchus mykiss* (based on 96 hr LC50 value)  
SMAV = 800 mg/L

*Pimephales promelas* (based on 96 hr LC50 values)  
SMAV =  $(301*741*440*766*843)^{1/5} = 575.9420$  mg/L

Because there is only one SMAV available for each genus, SMAV = GMAV. An Advisory Acute Value (AAV) was calculated by dividing the lowest GMAV (340.0740) by the appropriate uncertainty factor of 10, which is directly proportional to the number of available GMAVs. The table of uncertainty factors is in Appendix B.

AAV = 34.0074

### 3.1 Calculation of an Advisory Acute-Chronic Ratio

There are acceptable chronic values available for *Daphnia magna* and *Pimephales promelas*, (Table 2). Appropriate effect level values were selected from chronic tests according to the criteria listed on page 3 of Appendix A. The acute-chronic ratios (ACRs) are:

$$Daphnia magna - \frac{48 \text{ hr EC50}}{21\text{-day EC50 (young reproductive impairment)}} = \frac{266}{38} \approx 7$$

$$Daphnia magna - \frac{48 \text{ hr EC50}}{21\text{-day EC50 (adult mortality)}} = \frac{266}{40} \approx 7$$

(species mean ACR for *Daphnia magna*  $\approx 7$ )

$$Pimephales promelas - \frac{96 \text{ hr LC50}}{48 \text{ hr post-fertilization to 30 days post-hatch}} = \frac{766}{100} \approx 8$$

(hatchability of egg; survival and growth of fry)

The method requires at least 3 ACRs from at least 3 species of aquatic animals from three different families to calculate an Advisory Acute-Chronic Ratio (AACR). The literature offers only 3 ACRs from two different species. Therefore we assumed an AACR of 25 to calculate the advisory concentration, based on Kenaga (1982). This study of the relationship between the ACR and the type of chemical, type of species, etc, found that 93% of the 30 industrial chemicals investigated had an ACR  $\leq 25$ . Therefore, Kenaga (1982) determined that “the use of ACRs of 25 or less appears to be a good tool for predicting the chronic toxicity from the acute toxicity for organic industrial chemicals.” In addition, Kenaga (1982) found that there was no large variance in ACR values between species. He calculated an average ACR for daphnia (11), sheepshead minnow (15), coho salmon (5), and fathead minnow (13) exposed to 30 industrial organic chemicals. In most cases, the ACR for daphnia and fathead minnows was very similar for a given chemical. The similarity of our ACR values for daphnia and fathead minnows, 7 and 8 respectively, are consistent with Kenaga’s finding. Therefore, the use of an AACR of 25 appears

to be consistent with other studies performed on organic chemicals and is a conservative estimate of the chronic toxicity of C8 to aquatic organisms.

### 3.2 Advisory Concentration

The advisory concentration is calculated as the Advisory Acute Value/ Advisory Acute-Chronic Ratio.

$$\text{Advisory Concentration} = 34.0074/25 = 1.3603 \text{ mg/L}$$

USEPA (1986) requires that the advisory concentration be reported using the following language:

*If the measured or estimated ambient concentration of ammonium perfluorooctanoate exceeds 1.36 mg/L in fresh or salt water, one or more of the following options must be completed as quickly as possible:*

- 1) *obtain additional data concerning the concentration of ammonium perfluorooctanoate in the effluent and/or ambient water;*
- 2) *obtain additional laboratory and/or field data on the effect of ammonium perfluorooctanoate on aquatic organisms and their uses so that a new aquatic life advisory or a water quality criterion can be derived;*
- 3) *conduct acute and/or chronic toxicity tests on the effluent;*
- 4) *reduce the concentration.*

*After a reasonable period of time, unless a consideration of all available data concerning the ambient concentration and the effects of ammonium perfluorooctanoate on aquatic life demonstrate that the ambient concentration is low enough, it must be reduced.*

### 4.0 UNCERTAINTY

Due to the lack of a sufficient amount of data, we were unable to calculate ambient water quality criteria for C8. It is important to recognize that the calculated advisory concentration of 1.36 mg/L of C8 should not be used as a regulatory standard and is based on a measurable degree of uncertainty. The data set was limited in the amount of acceptable acute and chronic results and the number of species represented. In fact, we had to modify the procedure for calculating the advisory concentration to include acute tests from only one invertebrate species, instead of two. Further studies on the toxic effects of C8 to different species from different families required by USEPA (1985) could eventually lead to the development of ambient water quality criteria for C8.

## 5.0 REFERENCES

Kenaga, E.E. 1982. Predictability of chronic toxicity from acute tests of chemicals in fish and aquatic invertebrates. *Environmental Toxicology and Chemistry*. Vol. 1:pp.347-358.

USEPA, 1985, *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*. United States Environmental Protection Agency, Office of Water Regulations and Standards Criteria and Standards Division, Washington, D.C. and Office of Research and Development, Environmental Research Laboratory, Duluth, MN.

USEPA, 1986. *Guidelines for Deriving Ambient Aquatic Life Advisory Concentrations*. United States Environmental Protection Agency, Office of Regulations and Standards Criteria Division, Washington, D.C. and Office of Research and Development, Environmental Research Laboratory, Duluth, MN. NTIS 82212-86-100.

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## TABLES

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**Table 1**  
**Acute Toxicity of Ammonium Perfluorooctanoate to Aquatic Organisms**  
**West Virginia Ecological Toxicity Study**

Test Species	Exposure Route	Effect Endpoint	Exposure Duration	Effect Level	Compound <sup>(1)</sup>	Effect Concentration <sup>(2)</sup>	Nominal Test Concentrations	Reasons for Rejection of Results	Reference <sup>(6)</sup>
<i>Daphnia magna</i>	In water		48 hr (static, acute)	EC50	FC-143	126 (86-183) mg/L to >1000 mg/L	0, 10, 30, 100, 300, 1000 mg/L (5/82); 0, 10, 100, 500, 1000 (6/82)	Results rejected because of inconsistency: 48 hr EC50 from May, 1982 = >1000 mg/L; 48 hr EC50 from June, 1982 = 126 mg/L.	22
<i>Daphnia magna</i>	In water		48 hr (static, acute)	EC50	FC-143	360 (219-621) mg/L <sup>(4)</sup>	0, 430, 730, 1200, 2000, 3330 mg/L <sup>(3)</sup>		35
<i>Daphnia magna</i>	In water		48 hr (static, acute)	EC50	FC-143	266 (231-307) mg/L	0, 25, 40, 63, 100, 160, 250, 400, 630 mg/L		23
<i>Daphnia magna</i>	In water		24 hr (static, acute)	EC50	FC-143	416 (366-472) mg/L	0, 25, 40, 63, 100, 160, 250, 400, 630 mg/L	Results not included because the 48 hr EC50 value from the same study is used in the advisory concentration calculation. According to USEPA (1985), 48 hrs is a more appropriate acute exposure duration for daphnia than 24 hrs.	23
<i>Daphnia magna</i>	In water		48 hr (static, acute)	LC50	FC-143	632 (570-699) mg/L	7.5, 10, 18, 32, 56 mg/L		4
<i>Daphnia magna</i>	In water		48 hr (static, acute)	LC50	FC-143	720 mg/L		Results rejected because there is no reference made to the study from which the results were obtained. Therefore, it is impossible to confirm the validity of the test methods & results.	36
<i>Daphnia magna</i>	In water		48 hr (static, acute)	EC50	FC-126	221 (186-261) mg/L	0, 100, 180, 320, 560, 1000 mg/L		27
Diatoms	In water			50% growth reduction; safe level (7 days)	FC-143	2400 mg/L; 720 mg/L		Results rejected because there is no reference made to the study from which the results were obtained. Therefore, it is impossible to confirm the validity of the test methods & results.	(DuPont Co. Unpublished data) in Ref 3
<i>Dunaliella salina</i>	in vitro				C-8	The algae did not die, but also did not grow.		Results rejected because there is no reference made to the study from which the results were obtained. Therefore, it is impossible to confirm the validity of the test methods & results.	(DuPont Co. Unpublished data) in Ref 3
<i>Lepomis macrochirus</i>	In water		48 hr (static, acute)	LC50	FC-143	1550 mg/L		Results rejected because there is no reference made to the study from which the results were obtained. Therefore, it is impossible to confirm the validity of the test methods & results.	(DuPont Co. Unpublished data) in Ref 3
<i>Lepomis macrochirus</i>	In water		96 hr (static, acute)	LC50	FC-143	569 (500-636) mg/L	0, 420, 560, 750, 1000, 1350 mg/L		4, 16
<i>Lepomis macrochirus</i>	In water		96 hr (static, acute)	LC50	H-19704	634 (567-725) mg/L	0, 262, 328, 410, 512, 640, 800, 1000 mg/L		7
<i>Lepomis macrochirus</i>	In water		96 hr (static, acute)	LC50	FC-143	>420 mg/L	0, 135, 180, 240, 320, 420 mg/L		15
<i>Oncorhynchus mykiss</i>	In water		96 hr (static, acute)	LC50	FC-118	800 (665-986) mg/L <sup>(5)</sup>	0, 625, 1250, 2500, 5000, 10000 mg/L <sup>(3)</sup>		6
<i>Photobacterium phoshoreum</i>	In water	% light loss	30 min (static, acute)	EC50	FC-1015-X	1950 (1760-2160) mg/L	0, 416, 832, 1665, 3330 mg/L	Photobacterium phosphoreum is a single-celled organism. According to USEPA (1985) studies using single-celled organisms should not be used to calculate an ambient water quality criteria or advisory concentration.	31
<i>Photobacterium phoshoreum</i>	In water	% light loss	30 min (static, acute)	EC50	FC-118	3150 (2910-3420) mg/L	0, 625, 1250, 2500, 5000 mg/L	Photobacterium phosphoreum is a single-celled organism. According to USEPA (1985) studies using single-celled organisms should not be used to calculate an ambient water quality criteria or advisory concentration.	30

**Table 1**  
**Acute Toxicity of Ammonium Perfluorooctanoate to Aquatic Organisms**  
**West Virginia Ecological Toxicity Study**

Test Species	Exposure Route	Effect Endpoint	Exposure Duration	Effect Level	Compound <sup>(1)</sup>	Effect Concentration <sup>(2)</sup>	Nominal Test Concentrations	Reasons for Rejection of Results	Reference <sup>(6)</sup>
<i>Photobacterium phoshoreum</i>	In water	% light loss	30 min (static, acute)	EC50	FC-143	730 (630-850) mg/L	0, 125, 250, 500, 1000 mg/L	Photobacterium phosphoreum is a single-celled organism. According to USEPA (1985) studies using single-celled organisms should not be used to calculate an ambient water quality criteria or advisory concentration.	29
<i>Photobacterium phoshoreum</i>	In water	% light loss	30 min (static, acute)	EC50	FC-126	870 (810-930) mg/L	0, 420, 560, 750, 1000 mg/L	Photobacterium phosphoreum is a single-celled organism. According to USEPA (1985) studies using single-celled organisms should not be used to calculate an ambient water quality criteria or advisory concentration.	26
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FC-126	301 (244-370) mg/L	0, 100, 180, 320, 560, 1000 mg/L		28
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50; NOEC	FC-1015	741 (630-999) mg/L;	0, 530, 830, 1330, 2100, 3330 mg/L		33
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FC-26	440 mg/L	0, 50, 125, 250, 375, 500 mg/L		14
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FC-143	740 mg/L		The source referces a 3M report dated 3/27/96. This report is unavailable therefore, the results are rejected because it is not possible to confirm the validity of the test method and results.	36
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FC-143	766 (743-789) mg/L	0, 560, 650, 750, 870, 1000 mg/L		19
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FX-1001	843 (811-878) mg/L	0, 690, 750, 810, 870, 930 mg/L		24
<i>Pimephales promelas</i>	In water		96 hr (static, acute)	LC50	FC-143	70 mg/L	0, 10, 20, 30, 40, 50 mg/L	These results are rejected because the LC50 was extrapolated from an insufficient number of data points.	13
<i>Selenestrum capricornutum</i>	In water	Algal growth response	96 hr (static, acute)	EC50	FC-1015	1980 (1710-2360) mg/L (cell count); >3330 mg/L (growth rate)	0, 210, 430, 830, 1670, 3330 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	34
<i>Selenestrum capricornutum</i>	In water	Algal growth response	96 hr (static, acute)	NOEC	FC-1015	210 mg/L (cell count); 430 mg/L (growth rate)	0, 210, 430, 830, 1670, 3330 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	34
<i>Selenestrum capricornutum</i>	In water	Algal growth response	96 hr (static, acute)	LOEC	FC-1015	430 mg/L (cell count); 830 mg/L (growth rate)	0, 210, 430, 830, 1670, 3330 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	34
<i>Selenestrum capricornutum</i>	In water	Algal growth response	96 hr (static, acute)	EC50	FC-143	49 (28-75) mg/L (cell count); 149 (57-340) mg/L cell dry weight	0, 100, 180, 320, 560, 1000, 1800 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	21
<i>Selenestrum capricornutum</i>	In water	Algal growth response	168 hr (static, acute)	EC50	FC-143	30 (21-40) mg/L (cell count); 70 (34-118) mg/L (cell dry weight)	0, 100, 180, 320, 560, 1000, 1800 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	21
<i>Selenestrum capricornutum</i>	In water	Algal growth response	240 hr (static, acute)	EC50	FC-143	27 (8-50) mg/L (cell count); 49 (15-96) mg/L (cell dry weight)	0, 100, 180, 320, 560, 1000, 1800 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	21

**Table 1**  
**Acute Toxicity of Ammonium Perfluorooctanoate to Aquatic Organisms**  
**West Virginia Ecological Toxicity Study**

Test Species	Exposure Route	Effect Endpoint	Exposure Duration	Effect Level	Compound <sup>(1)</sup>	Effect Concentration <sup>(2)</sup>	Nominal Test Concentrations	Reasons for Rejection of Results	Reference <sup>(6)</sup>
<i>Selenestrum capricornutum</i>	In water	Algal growth response	336 hr (static, acute)	EC50	FC-143	43 (14-81) mg/L (cell count); 73 (25-147) mg/L (cell dry weight)	0, 100, 180, 320, 560, 1000, 1800 mg/L	Plant data are not used in the calculation of an advisory concentration because, according to USEPA (1986), most aquatic plant species are protected if aquatic animal species are protected.	21
Snails	In water		48 hr	LC50	FC-143	820 mg/L		Results rejected because there is no reference made to the study from which the results were obtained. Therefore, it is impossible to confirm the validity of the test methods & results.	(DuPont Co. Unpublished data) in Ref 3
Microbes	Activated sludge	Respiration Inhibition	3 hr (static, acute)	EC50	FC-126	>1000 mg/L (38% inhibition of respiration rate)	2 blanks, 100, 180, 320, 560, 1000 mg/L	These results are not comparable to results from other tests because the exposure medium differs. In addition, the other components of activated sludge are unknown. In addition, microbes are single-celled organisms which should not be used to calculate an ambient water quality criteria or advisory concentration.	25
Microbes	Activated sludge	Respiration Inhibition	3 hr (static, acute)	EC50	FC-1015-X	>3320 mg/L	2 blanks, 420, 840, 1660, 3320 mg/L	These results are not comparable to results from other tests because the exposure medium differs. In addition, the other components of activated sludge are unknown. In addition, microbes are single-celled organisms which should not be used to calculate an ambient water quality criteria or advisory concentration.	32
Microbes	Activated sludge	Respiration Inhibition	7 min (acute)	Inhibitory effect	FC-143	No acute inhibitory effect.	0, 1000 mg/L	These results are not comparable to results from other tests because the exposure medium differs. In addition, the other components of activated sludge are unknown. In addition, microbes are single-celled organisms which should not be used to calculate an ambient water quality criteria or advisory concentration.	20

Notes:

EC50 - Median Effective Concentration. This is the concentration of the test substance that causes 50% effect on specific characteristics of the test organism (ex. Immobilization of 50% of Daphnia, reduction in algal cell growth by 50% as compared to controls) after specified exposure period.

IC50 - Mean Inhibitory Concentration. This is the concentration of the test substance that inhibits biological processes of the test organism by 50% (ex. Light production, respiration) after the specified exposure period.

LC50 - Median Lethal Concentration. This is the concentration of the test substance that kills 50% of the test organisms after a specified exposure period.

LOEL - Lowest Observed Effect Level.

NOEC - No Observed Effect Level.

NOEL - No Observed Effect Level.

*Daphnia magna* - Water flea.

*Dunaliella salina* - A freshwater algae.

*Lepomis macrochirus* - Bluegill sunfish.

*Oncorhynchus mykiss* - Rainbow trout.

*Pimephales promelas* - Fathead minnow.

*Selenestrum capricornutum* - A freshwater green algae.

<sup>(1)</sup> - Ammonium perfluorooctanoate is the common name for octanoic acid, perfluorooctanoate, ammonium salt. All compounds listed in this column are synonyms for this chemical.

<sup>(2)</sup> - Values in parentheses represent the 95% confidence interval for the given effect level.

<sup>(3)</sup> - Test concentrations refer to the concentrations of the original test substance, not the corrected concentrations for the assumed % purity of ammonium perfluorooctanoate

<sup>(4)</sup> - The test substance is FC-1015, a substance of uncertain purity. According to the 3M reviewer, the test substance is most likely composed of a 30% straight carbon chain version of FC-143 in 80% water. Therefore the 48 hr EC50, 1200 mg/L, of FC-1015 was corrected for the assumed purity of 30% ammonium perfluorooctanoate (FC-143).

<sup>(5)</sup> - The test substance is H-24215, a 20% solution of FC-118. The 96 hr LC50 for H-24215 of 4001 (3327-4932) mg/L was corrected for the assumed purity of 20% ammonium perfluorooctanoate (FC-118).

<sup>(6)</sup> - The list of references can be found in Appendix C.

Highlighted values indicate that the results were used to calculate an advisory concentration for ammonium perfluorooctanoate.

**Table 2**  
**Chronic Toxicity of Ammonium Perfluorooctanoate to Aquatic Organisms**  
**West Virginia Ecological Toxicity Study**

Test Species	Exposure Route	Effect Endpoint	Exposure Duration	Effect Level	Compound <sup>(1)</sup>	Effect Concentration <sup>(2)</sup>	Nominal Test Concentrations	Observations	Reasons for Rejection of Results	Reference <sup>(4)</sup>
<i>Daphnia magna</i>	In water	Adult mortality	14 & 21 days with renewal every 2 days (semi-static chronic)	EC50	FC-143	14-day EC50 = >60 mg/L; 21-day EC50 = 40 (31-52) mg/L <sup>(3)</sup>	0, 5, 8, 13, 22, 36, 60 mg/L	All surviving 1st generation Daphnids appeared normal at test termination. Survival in 36 & 60 mg/L treatments was statistically significant (ie. p <= 0.05) from negative control group.	Results not used because there were not enough chronic studies to develop the appropriate number of ACRs to calculate an advisory concentration. Instead an assumed AACR of 25 was used.	23
<i>Daphnia magna</i>	In water	Young reproduction impairment	14 & 21 days with renewal every 2 days (semi-static chronic)	EC50	FC-143	14-day EC50 = 33 (26-45) mg/L; 21-day EC50 = 38 (35-42) mg/L <sup>(3)</sup>	0, 5, 8, 13, 22, 36, 60 mg/L	Daphnids in control produced neonates on day 7. Reproduction is statistically significant (ie. p <= 0.05) from control (Dunnett's) at 13, 22, 36 & 60 mg/L test soln. after 14 days & in 36 & 60 mg/L test soln. at 21 days.	Results not used because there were not enough chronic studies to develop the appropriate number of ACRs to calculate an advisory concentration. Instead an assumed AACR of 25 was used.	23
<i>Pimephales promelas</i>	In water	Hatchability of egg; Survival & growth of fry (early life-cycle test)	48 hr post-fertilization to 30 days post-hatch	No adverse effect (no observed reductions in hatchability, % survival & growth)	FC-143	100 mg/L	0, 6.2, 12.5, 25, 50, 100 mg/L	3M reviewer notes a lack of information on purity & analysis of test substance concentrations and preserved fry or frozen fry samples.	Results not used because there were not enough chronic studies to develop the appropriate number of ACRs to calculate an advisory concentration. Instead an assumed AACR of 25 was used.	17
<i>Pimephales promelas</i>	In water	Histological - tissue change (early life-cycle test)	48 hr post-fertilization to 30 days post-hatch	no "significant, demonstrable" tissue change	FC-143	100 mg/L	0, 6.2, 12.5, 25, 50, 100 mg/L	Any changes observed were judged to be minimal and consistent with any routine changes seen in healthy fish.	Results not used because there were not enough chronic studies to develop the appropriate number of ACRs to calculate an advisory concentration. Instead an assumed AACR of 25 was used.	18

Notes:

EC50 - Median Effective Concentration. This is the concentration of the test substance that causes 50% effect on specific characteristics of the test organism (ex. Immobilization of 50% of Daphnia, reduction in algal cell growth by 50% as compared to controls) after specified exposure period.

IC50 - Mean Inhibitory Concentration. This is the concentration of the test substance that inhibits biological processes of the test organism by 50% (ex. Light production, respiration) after the specified exposure period.

LC50 - Median Lethal Concentration. This is the concentration of the test substance that kills 50% of the test organisms after a specified exposure period.

NOEC - No Observed Effect Level.

*Daphnia magna* - Water flea.

*Pimephales promelas* - Fathead minnow.

<sup>(1)</sup> - Ammonium perfluorooctanoate is the common name for octanoic acid, pentadecafluoro-, ammonium salt. All compounds listed in this column are synonyms for this chemical.

<sup>(2)</sup> - Values in parentheses represent the 95% confidence interval for the given effect level.

<sup>(3)</sup> - Results derived using the Moving Average Angle Method.

<sup>(4)</sup> - The list of references can be found in Appendix C

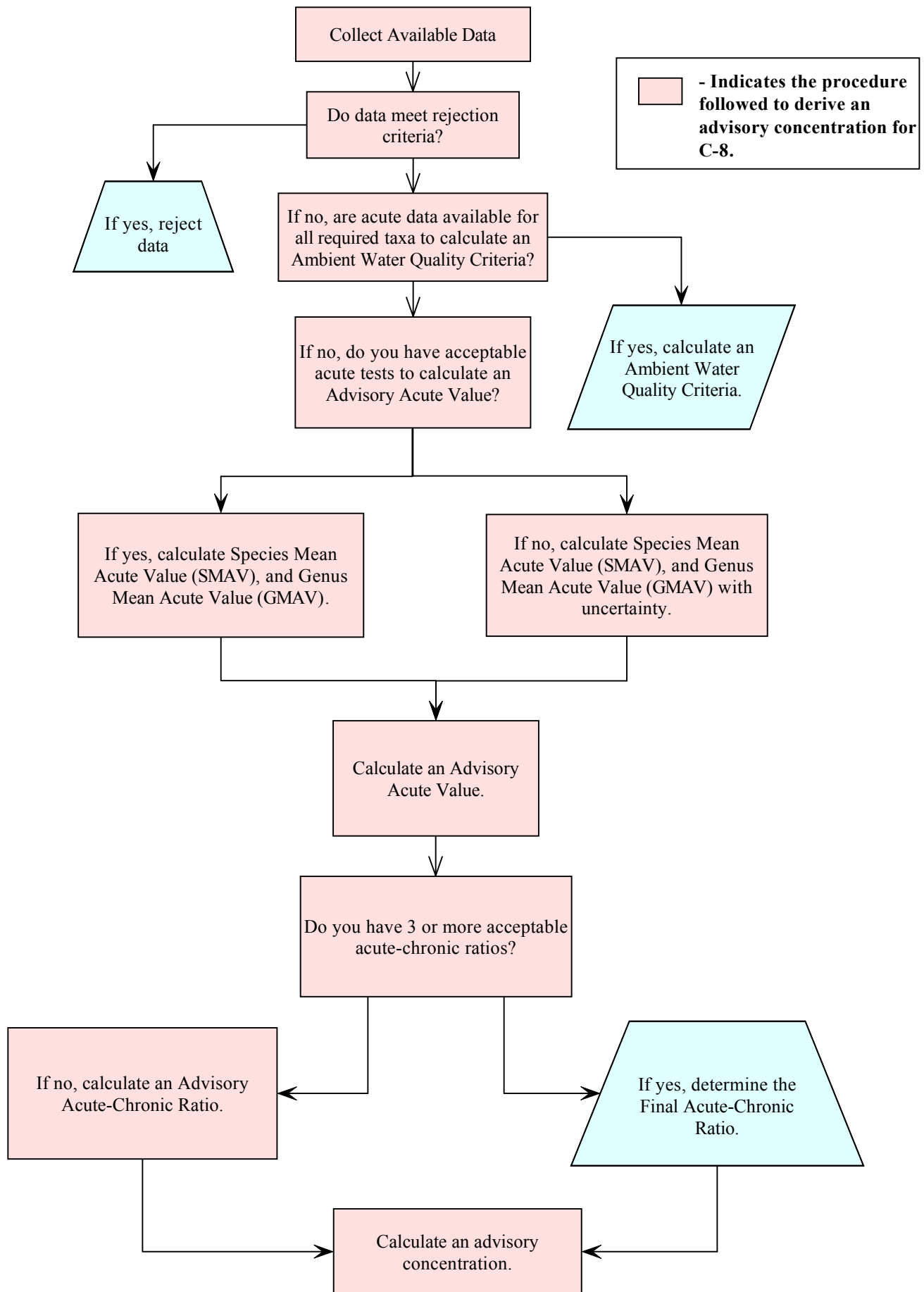
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## **FIGURES**

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**Figure 1**

**Derivation of an Aquatic Life Advisory Concentration for Ammonium Perfluorooctanoate**



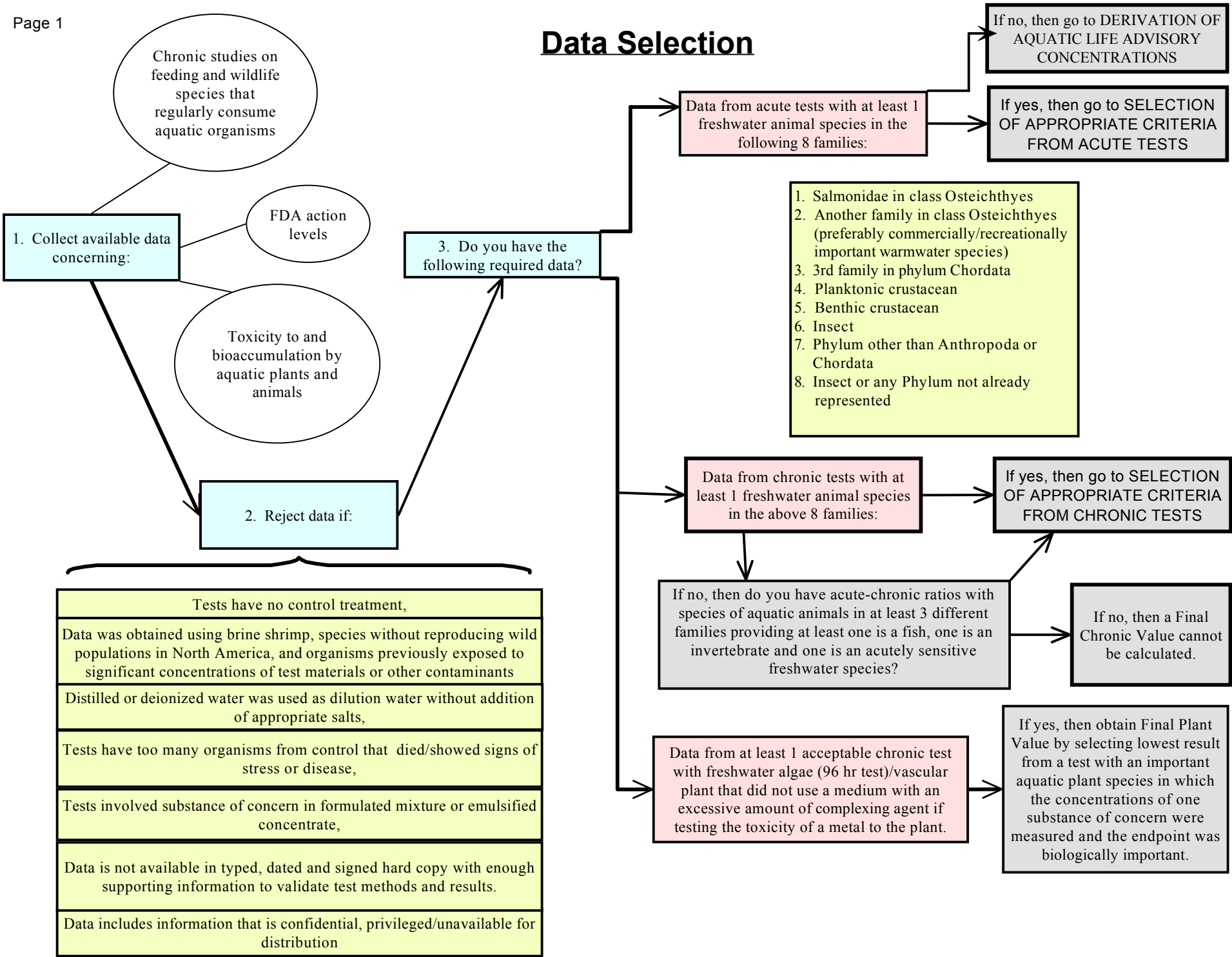
Note: Refer to Appendix A for details on methodology.

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**APPENDIX A**

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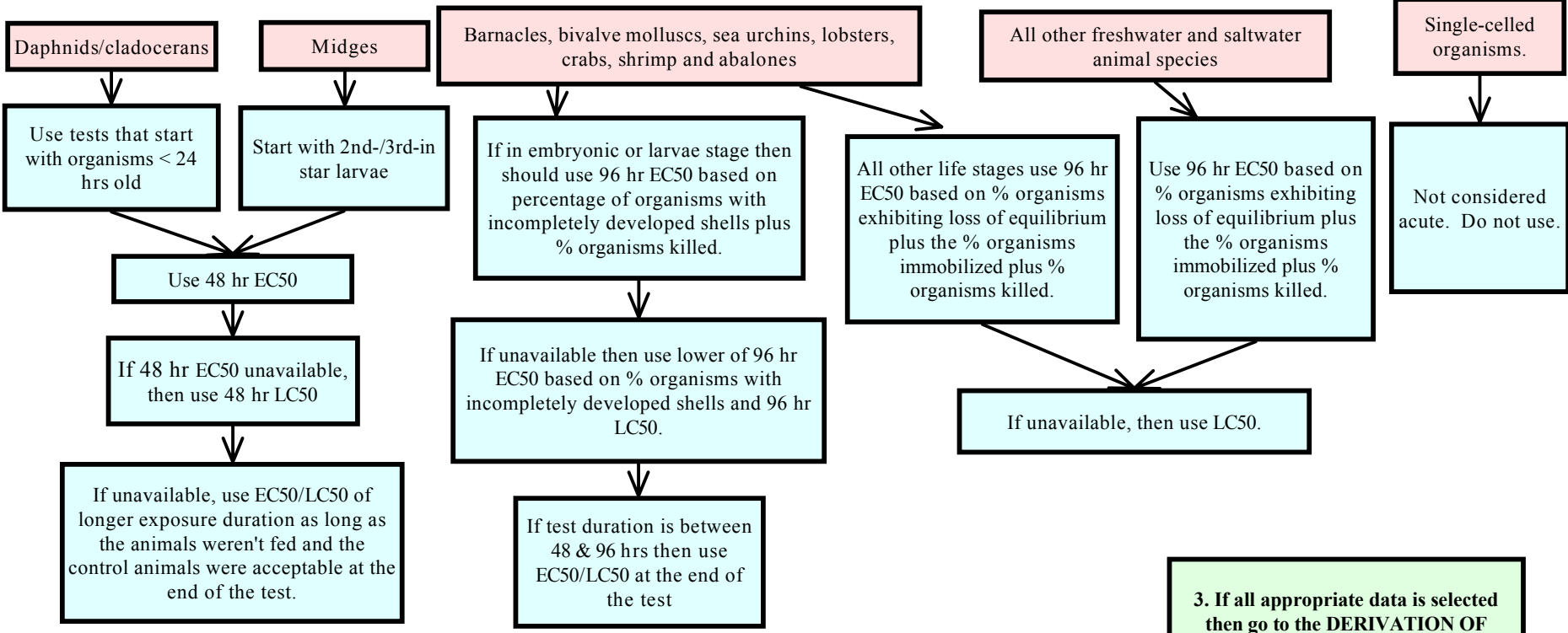
# Data Selection



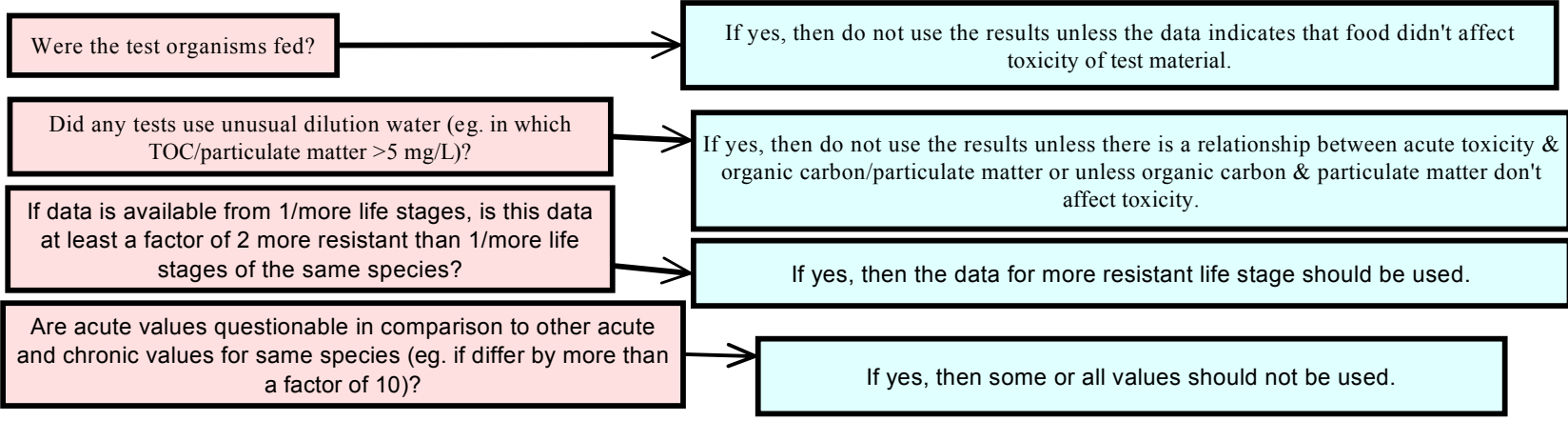


# Selection of Appropriate Criteria from Acute Tests

## 1. What acute criteria should be used for the following organisms?



## 2. Do any of the tests have any of the following problems?



## 3. If all appropriate data is selected then go to the DERIVATION OF FINAL ACUTE VALUE

# Selection of Appropriate Criteria from Chronic Tests

1. What exposure durations should be used?

2. What data should be used as chronic values?

Fish

Use results based on flow-through chronic tests with test concentrations measured. Tests need to begin with embryos/newly hatched young < 48 hrs old, continue through maturation & reproduction and finish  $\geq$  24 days (90 days for salmonids) after hatching of next generation.

For partial life-cycle tests need to begin with immature juveniles  $\leq$  2 months prior to active gonad development & continue through maturation & reproduction, finishing  $\geq$  24 days (90 for salmonids) after hatching next generation.

Early life-cycle tests need to start just after fertilization through early juvenile development.

Use data on survival & growth of adults & young, maturation of males & females, eggs spawned/ female embryo viability (salmonids only), & hatchability.

If life-cycle/partial life-cycle data available don't use.

If the incidence of mortality/abnormalities increases significantly near the end then don't use.

Daphnids

Chronic renewal tests in addition to flow-through chronic tests are appropriate. Tests need to begin with young < 24 yrs old and continue until  $\geq$  21 days.

Use data on survival & young/female.

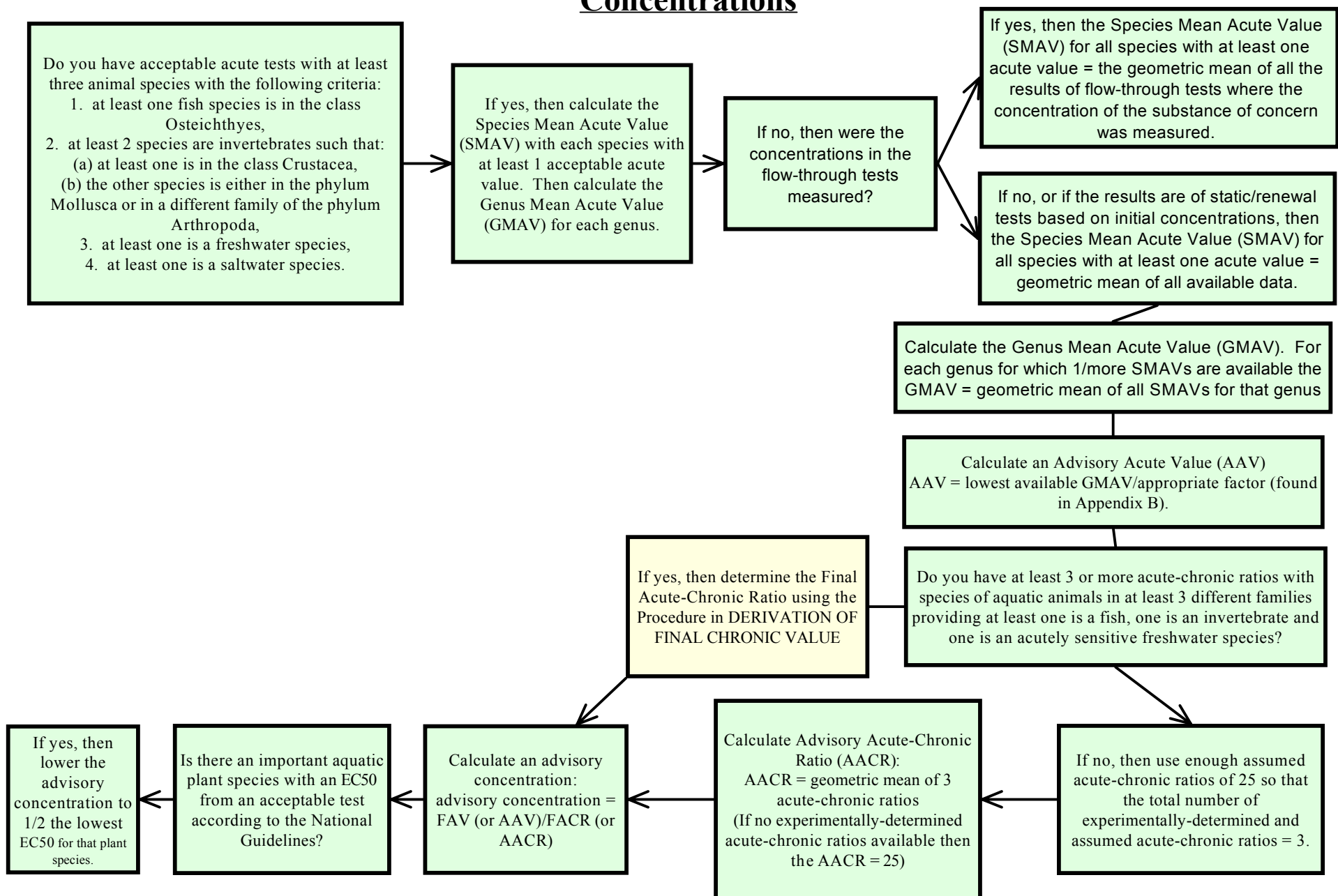
Mysids

Tests must begin with young < 24 hrs old and continue until 7 days past median time of 1st brood release in the controls.

Use data on survival, growth & young/female.

3. Once the appropriate data has been selected go to the DERIVATION OF FINAL CHRONIC VALUE

## Derivation of Aquatic Life Advisory Concentrations



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## **APPENDIX B**

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Appendix B  
Factors to be used in the calculation of an  
Advisory Acute Value

Number of GMAVs	Factor
3	11.0
4	10.0
5	9.0
6	8.0
7	7.0
8	6.0
9	5.0
10	4.0
11	3.8
12	3.6
13	3.4
14	3.2
15	3.0
16	2.8
17	2.6
18	2.4
19	2.2
20 or more	2.0

USEPA, 1986. Guidelines for Deriving Ambient Aquatic Life Advisory Concentrations. United States Environmental Protections Agency, Office of Regulations and Standards Criteria Division, Washington, D.C. and Office of Research and Development, Environmental Research Laboratory, Duluth, MN. NTIS 82212-86-100.

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## **APPENDIX C**

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## Appendix C

### References:

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- 6) Muska, C. F. December, 1999. Trade Secret; Study Title: H-24215: Static, Acute, 96 Hour LC50 to Rainbow Trout, *Oncorhynchus mykiss*.
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- 21) 3M Company, Environmental Laboratory. 1981. Technical Report Summary – Multi-phase, Exposure/Recovery Algal Assay Test Method (FC-143).
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- 26) 3M Company, Environmental Laboratory. 1987. Microtox test – FC-126.
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- 31) 3M Company, Environmental Laboratory. 1996. Microtox Test – FC-1015X.
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