Water Quality Standards Public Meeting
Human Health Criteria & Algae Update

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Water Quality Standards Public Meeting
Agenda

- Schedule of upcoming Water Quality Standards review
- Human Health Criteria Bioaccumulation Factors
- Nutrients and Algae Update by Chris Smith
- Discussion and Questions

Agenda uploaded on 8/14/19 to
https://dep.wv.gov/WWE/Programs/wqs/Pages/WQSpublicmeetings.aspx

Mandate from WV Legislature to propose in 2020

Added Subsection 8.6. to 47CSR2:

On or before April 1, 2020, the Secretary shall propose updates to the numeric human health criteria found in Appendix E., subsection 8.23 Organics and subsection 8.25 Phenolic Materials to be presented to the 2021 Legislative Session. The Secretary shall allow for submission of proposed human health criteria until October 1, 2019, and for public comment and agency review for an appropriate time thereafter.

Review of Triennial Review
Legislative Review

2019 **May** – Held public meeting to further discuss potential criteria revisions

August – Holding this WQS public meeting

By October 1st – DEP will receive any submissions of proposed human health criteria

November – Hold Public Meeting to hear presentations of any submittals proposed

proposal of Human Health Criteria Timeline

2020 **March** – Hold WQS Public Meeting to propose human health criteria revisions

June – Put out official public notice version of criteria revisions

July – Hold public hearing and submit Agency-Approved rule for Legislative review

Fall 2020 – Rule will be reviewed by Legislative Rule-Making Review Committee

2021 **Legislative Session** – Legislature will review proposed rule

Human Health Criteria
Bioaccumulation Factors, or "BAFs"

"Bioaccumulation"

- Refers to the uptake and retention of a chemical by an aquatic organism from all surrounding media, such as food, water and sediment

as opposed to "Bioconcentration"

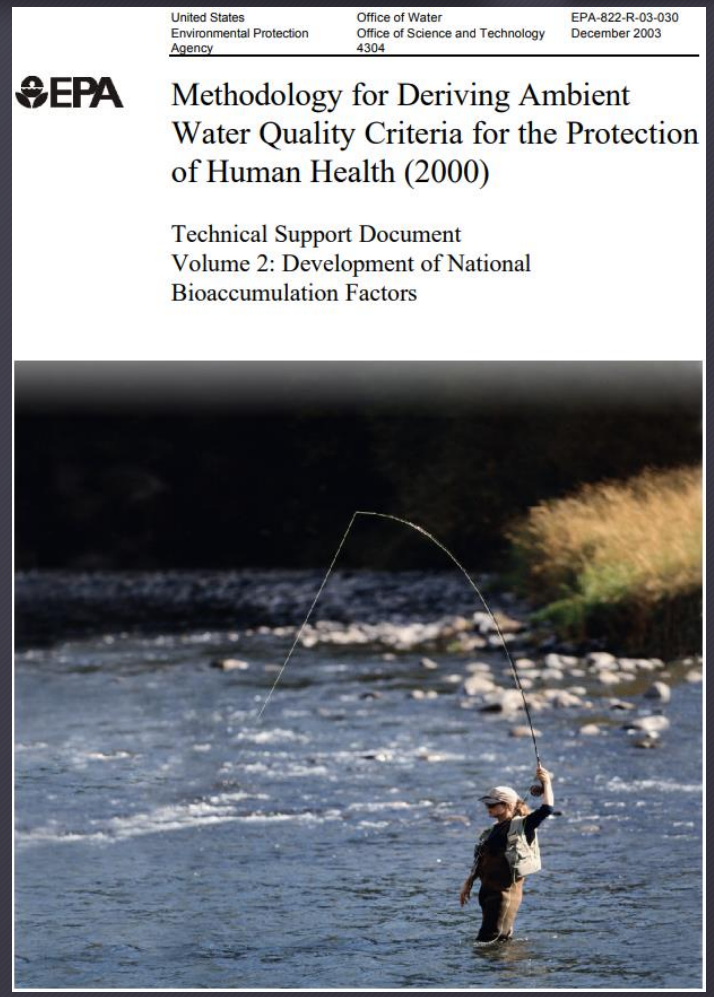
- Refers to the uptake and retention of a chemical by an aquatic organism from water only

- EPA 2000 *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* emphasizes using BAFs when possible

Bioaccumulation can be substantially greater than bioaccumulation for chemicals that are that are highly persistent and/or hydrophobic

Human Health Criteria
EPA's development of national BAFs

- Approach was to develop a long-term average bioaccumulation potential in aquatic organisms which are commonly consumed in the U.S.
- EPA estimated BAFs using its 2000 *Methodology* and its *Technical Support Document, Volume 2: Development of National Bioaccumulation Factors*
- EPA followed approach from Figure 3-1 of Tech Support Document, which provides different methods to derive the most appropriate BAF for each chemical



Human Health Criteria
Methods for Deriving most appropriate BAF

BAF Method

- Uses measured BAFs derived from data obtained from field studies
- Field-measured BAFs were normalized by adjusting for the water-dissolved portions of the chemical and the lipid fraction of fish tissue for each species, as well as the fraction of the total concentration of chemical in water that is freely dissolved.
- Averaged multiple field BAFs using geomean of normalized BAFs by species and trophic level
- Averaged BAFs across species to compute trophic level-based BAFs
- Adjusts the BAFs by national default values for lipid content, organic carbon content, and the K_{ow}
- EPA used 50th percentile for organic carbon content

Source: https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OW-2014-0135-0234&contentType=pdf

Human Health Criteria
Methods for Deriving most appropriate BAF

BCF Method

- Uses BAFs estimated from laboratory-measured bioconcentration factors (BCFs) with or without adjustment by a food chain multiplier.
- Similar to field BAFs, laboratory-measured BCFs are normalized with the lipid fraction and the fraction of the total concentration of chemical in water that is freely dissolved, then multiplied by the food chain multiplier where applicable.
- Averaged using geomean across species and across trophic levels to compute baseline BAFs
- Adjusts the BAFs by national default values for lipid content, organic carbon content, and the K_{ow}
- EPA used 50th percentile for organic carbon content

Source: https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OW-2014-0135-0234&contentType=pdf

Human Health Criteria
Methods for Deriving most appropriate BAF

K_{ow} Method

This method predicts BAFs based on a chemical's Octanol-Water Coefficient (or K_{ow}) with or without adjustment using a food chain multiplier

$$K_{ow} = \frac{\text{Amount of chemical in octanol}}{\text{Amount of chemical in water}}$$

Basically K_{ow} measures the tendency of a chemical to stay in lipids vs go into water, or its hydrophobicity

Source: https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OW-2014-0135-0234&contentType=pdf

Human Health Criteria
EPA Decision Tree / Framework

Figure 3-1 from Tech Support Document

For example, acenaphthene:

- Nonionic organic chemical
- Low hydrophobicity (K_{ow} < 4)
- High metabolism

For acenaphthene EPA was not able to locate peer-reviewed BAFs or lab-measured BCFs for all three trophic levels, so EPA used available BCF for TL3 to estimate and derive national BAF for acenaphthene of 510 L/kg

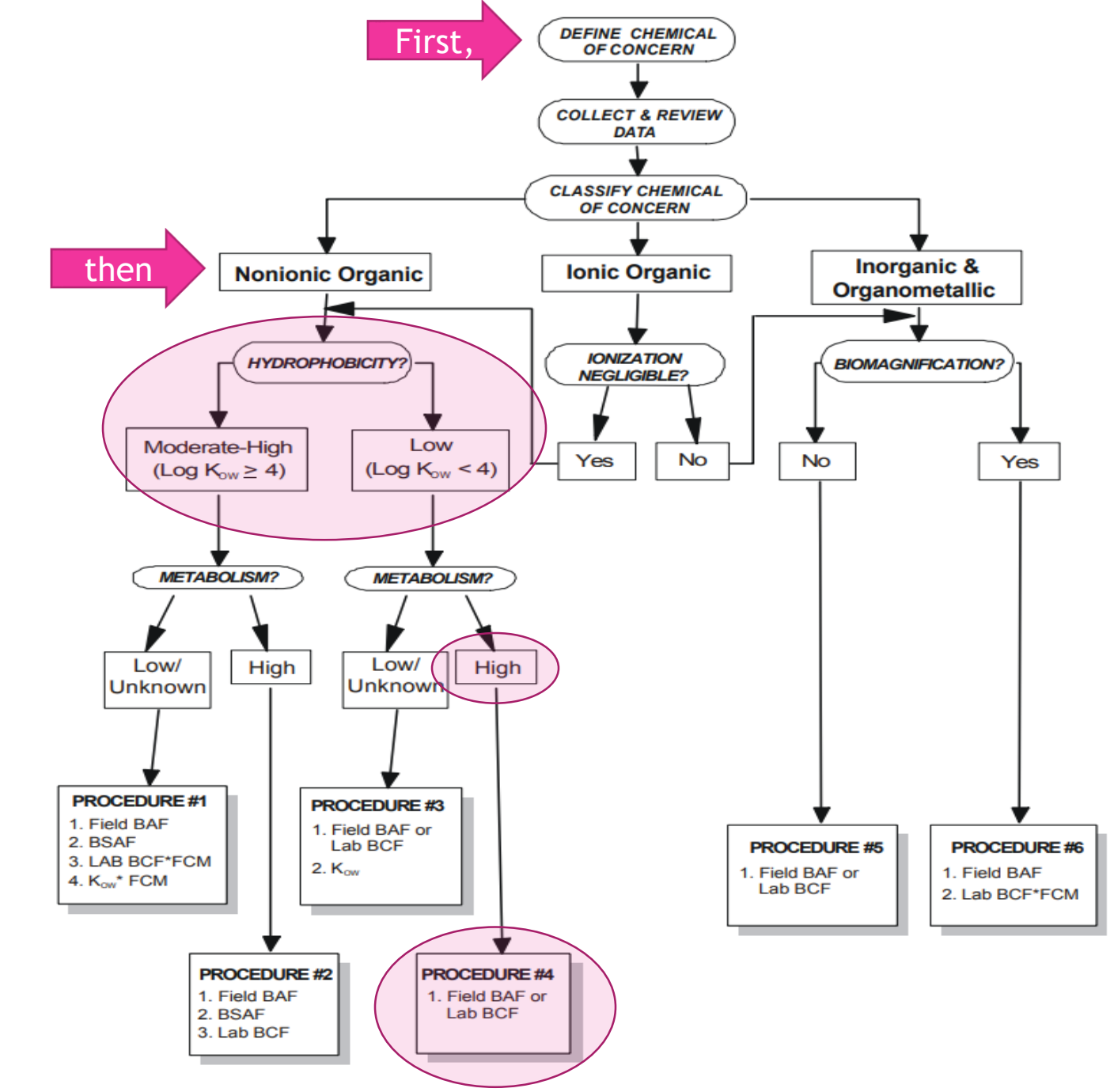
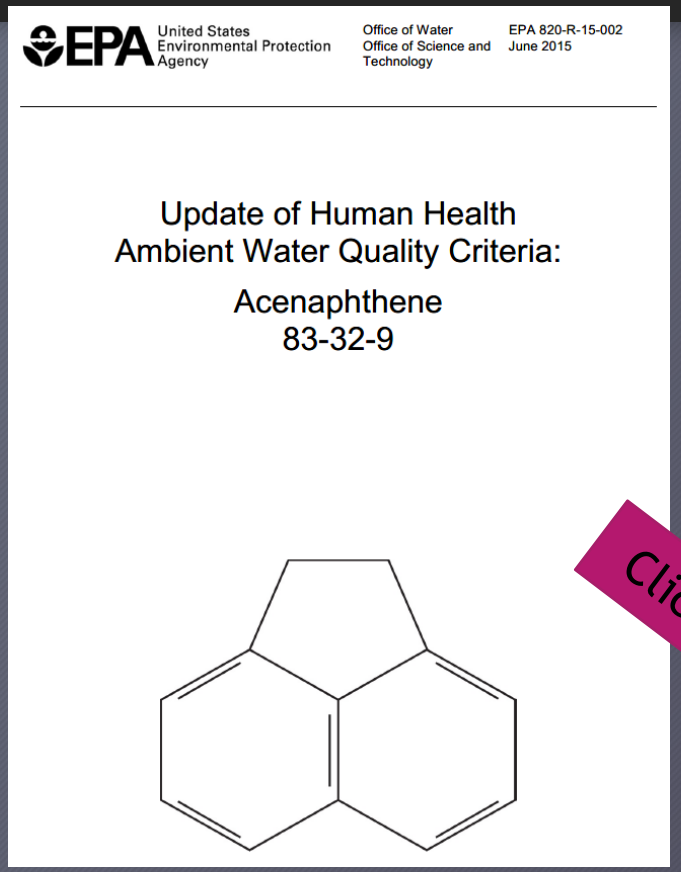


Figure 3-1. Framework for selection of methods for deriving national BAFs.

Specific Criteria Documents
Nat'l Recommended WQC HHC Table


EPA United States Environmental Protection Agency | Office of Water, Office of Science and Technology | EPA 820-R-15-002, June 2015

Update of Human Health Ambient Water Quality Criteria:

Acenaphthene
83-32-9

https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table

Click Here!

Pollutant	CAS Number	Human Health for the consumption of Water + Organism (µg/L)	Human Health for the consumption of Organism Only (µg/L)	Publication Year
Acenaphthene (P)	83329	70	90	2015

Jennie Henthorn, Manufacturer's Association

Update from ongoing study of EPA's Bioaccumulation Factors

Determination of Criteria Factors

	CSF (per mg/kg-d)	RfD (mg/kg-d)	WV RSC	Bioaccumulation Factor (L/kg tissue) TL2	TL3	TL4	WV Cat A Criteria (µg/l)	WV Cat C Criteria (µg/l)	Drinking Water (µg/l)
1,1,1-Trichloroethane	ND	2	0.2	6.9	9	10	12868	369046	13333
1,1,2,2-tetrachloroethane	0.2	0.02	0.2	5.7	7.4	8.4	0.2	5.6	0.2
Aldrin	17	0.00003	0.2	18000	310000	650000	0.0000014	0.0000014	0.0020

Summary of Studies Reviewed

Studies Located	119
Studies Not Located	42
TOTAL	161

Study Age

Undated	2
2010-2019	3
2000-2009	9
1990-1999	50
1980-1989	63
1970-1979	34
TOTAL	161

Example Study in EPA Spreadsheet

Chemical Name	BAF or BCF?	Secondary Citation	Species	Log BAF or BCF (ORIGINAL - TEXT)	Converted BAF or BCF (L/kg-tissue) (ORIGINAL - TEXT)
1,2,4-Trichlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.40	250.00
2,4-Dichlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.41	260.00
2,4-Dichlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Golden ide		100
Hexachlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	5.39	248000.00
Pentachlorobenzene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	3.60	4000.00
Pentachlorophenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	3.10	1250.00
Phenol	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.30	200.00
Toluene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	2.58	380.00
Trichloroethylene	BCF	Freitag, D., Ballhorn, L., Geyer, H. and F. Korte 1985	Green algae (Chlorella fusca)	1.95	90.00
Vinyl Chloride	BCF	Freitag et al. 1985	Algae		40.00
Vinyl Chloride	BCF	Freitag et al. 1985	Fish		<10
Vinyl Chloride	BCF	Freitag et al. 1985	Golden Ide (Fish)		<10

Golden Ide Data from Study

- Data in yellow indicates parameters reported in the Freitag study but not included in the EPA database.

Table 3: Bioaccumulation of Organic Chemicals in Fish (Golden ide)

Bioaccumulationsfactor: BF_n = concentration of chemical in fish (ug/g)* / medium conc. of chemical in water (ug/g)

n = 3 days

2,5,4'-Trichlorobiphenyl	3,850	2,6-Dichlorobenzonitrile	40
2,4'-Dichlorobiphenyl	3,550	Malonic acid diethyl ester	40
2,4,6,2'-Tetrachlorobiphenyl	3,150	Carbaryl	30
Dieldrin	3,010	Naphthalene	30
Pentachlorobenzene	3,000	Acetic acid ethyl ester	30
Aldrin	2,760	Chlorferon	20
2,2'-Dichlorobiphenyl	2,420	Monolinuron	20
Hexachlorobenzene	2,320	Phenol	20
2,4,6,2,4'-Pentachlorobiphenyl	2,320	3-Cresol	20
DDT	1,900	Dibenz(a,h)anthracene	10
Phenanthrene	1,760	4-Chloroaniline	10
Hexachlorocyclopentadiene	1,230	Captan	10
Quintozene	1,140	Cortisone acetate	10
Anthracene	910	Sencor	10
2,6-Di-tert-butylphenol	660	Ethylene glycol	10
3,3'-Dichlorobenzidine	610	2,6-Dichlorobenzamide	10
Kepone	570	Docosane	10
1,2,4-Trichlorobenzene	490	Acetic acid (Na-salt)	<10
Benzo(a)pyrene	480	Zineb	<10
β-Hexachlorocyclohexane	450	Maneb	<10
Cypermethrin	420	Succinic anhydride	<10
γ-Hexachlorocyclohexane	371	Perylene	<10
Benz(a)anthracene	350	4-Bromobenzoic acid	<10
2,4,6-Trichloroaniline	330	p-Phenylenediamine(hydrochloride)	<10
2,4,6-Trichlorophenol	310	(2,4-Dichlorophenoxy)acetic acid	<10
Biphenyl	280	Benzene	<10
Pentachlorophenol	260	Benzoic acid	<10
4-Isopropylnitrobenzene	190	Methanol	<10
Dodecylbenzenesulphate (Na-salt)	130	Aniline	<10
4-tert-Butylphenol	120	Tristearin	<10
Palmitic acid ethyl ester	110	Maleic acid	<10
Coumaphos	110	N-Benzyl-N-methylnitrosamine	<10
Diethylene glycol	100	4-Chlorbenzoic acid	<10
2,4-Dichlorophenol	100	Carbon tetrachloride	<10
Toluene	90	Belgard	<10
Trichloroethylene	90	Atrazine	<10
2,4-Dichloronitrobenzene	80	Urea	<10
Benzidine	80	ADPA	<10
Chlorobenzene	70	Nitrobenzene	<10
Palmitic acid	60	Vinyl chloride	<10
Hexadecanol	60	2,4-Dichlorobenzoic acid	<10
Dodecane	50	Thiourea	<10
Bromobenzene	50	Ethylenediamine(hydrochloride)	<10
1,4-Dichlorobenzene	50	ICM 2100	<10
4-Nitrophenol	40	2-Nitropropane	<10
Chlorhexidine	40	Propylene thiourea	<10
Hydroquinone	40	Ethylene thiourea	<10
Phthalic acid bis-(2-ethylhexyl)ester	40	Coumarin	<10

EPA's Order of Preference for Determination of Bioaccumulation Factors:

1) BAF - Bioaccumulation Factors calculated from actual exposure in surface waters
2) BSAF – Bio-sediment Accumulation Factors calculated from sediment exposures
3) BCF – Bioconcentration Factors calculated from laboratory exposure studies
4) Log K_{ow} – Calculated values based on the octanol-water partition coefficient for the chemical

Basis for EPA Recommended Bioaccumulation Factors

Calculated from K_{ow}	33
BCF Method	10
BAF Method	9
Copied from Benzo(a)pyrene	6
TOTAL	58

Factors Used in BAFBCF™ to Calculate BAFs

- Weight of organisms
- Mean water temperature
- Overall food web biomagnification factor
- Maximum trophic level dilution factor
- Lipid content of lowest trophic level organisms (TL1)
- Lipid fractions for TL2, TL3, and TL4 fish
- Fraction of freely dissolved chemical in the water

Discussion

What questions do you have on human health criteria and bioaccumulation factors?

Chris Smith

Update on Algae and Nutrients