Rule 57 Aquatic Values Data Sheet

Chemical or product name: Boron
C.A.S #: 7440-42-8

Developed by: Bill Dimond
Approved by: D. Bush
Approval date: 12/29/2011
Literature Search Date: 9/28/2011

FAV:* 69.000 ug/l (Tier: I)
AMV:* 34.000 ug/l (Tier: I)
FCV:* 7.200 ug/l (Tier: I)

ACUTE DATA

Species	Test type (EC or LC50)	Duration (hours)	Test conditions (FT,M, etc.)	Hardness/ Alkalinity[1] mg/L	Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Fathead Minnow	LC50	96	SR,M	84	H_3BO_3	75,900	77,777	77,777	1	1
(*Pimephales promelas*)	LC50	96	S,M	91	H_3BO_3 and $Na_2B_4O_7$	79,700				10
Water Flea	LC50	48	SR,M	84	H_3BO_3	85,200	85,114	85,114	2	1
(*Ceriodaphnia dubia*)	LC50	48	S,M	96/94	H_3BO_3	45,500				9
	LC50	48	S,M	290/95	H_3BO_3	50,800				9
	LC50	48	S,M	168/167	H_3BO_3	50,600				9
	LC50	48	S,M	508/167	H_3BO_3	62,800				9
	LC50	48	S,M	100/94 [2]	H_3BO_3	99,400				9
	LC50	48	S,M	90/188 [2]	H_3BO_3	134,100				9
	LC50	48	S,M	90/60 [3]	H_3BO_3	83,800				9
	LC50	48	S,M	90/60 [3]	H_3BO_3	60,900				9
	LC50	48	S,M	90/60 [4]	H_3BO_3	72,100				9
	LC50	48	S,M	90/60 [4]	H_3BO_3	78,800				9
	LC50	48	S,M	120/75 [5]	H_3BO_3	62,400				9
	LC50	48	S,M	120/75 [5]	H_3BO_3	75,500				9
	LC50	48	S,M	120/75 [5]	H_3BO_3	85,200				9
	LC50	48	S,M	120/75 [5]	H_3BO_3	90,800				9
	LC50	48	S,M	120/75 [5]	H_3BO_3	89,900				9

Species	Test type (EC or LC50)	Duration (hours)	Test conditions (FT,M, etc.)	Hardness/ Alkalinity[1] mg/L	Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Water Flea (continued)	LC50	48	S,M	90 [6]	H_3BO_3	102,000				10
(*Ceriodaphnia dubia*)				91 [6,7]		165,000				
				89 [6,7]		109,000				
				282 [7]		104,000				
				469 [7]	H_3BO_3 and $Na_2B_4O_7$	93,000				
				85 [8]		91,000				
				87 [9]		115,000				
				84 [10]		142,000				
Amphipod	LC50	96	SR,M	84	H_3BO_3	94,900	136,600	136,600	3	1
(*Hyalella azteca*)	LC50	96	S,M	106 [11]		107,000				10
				302 [11]		151,000				
				507 [11]		170,000				
				111 [12]		269,000				
				291 [12]	H_3BO_3 and $Na_2B_4O_7$	203,000				
				475 [12]		188,000				
				102 [13]		104,000				
				102 [14]		127,000				
				103 [15]		64,000				
Fatmucket *(Lampsilis siliquidea)*	LC50	96	S,M	90	H_3BO_3 and $Na_2B_4O_7$	137,000	137,000	137,000	4	10
Black Sandshell *(Ligumia recta)*	LC50	96	S,M	91	H_3BO_3 and $Na_2B_4O_7$	147,000	147,000	147,000	5	10

Species	Test type (EC or LC50)	Duration (hours)	Test conditions (FT,M, etc.)	Hardness/ Alkalinity[1] mg/L	Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Water Flea	LC50	48	S,U	166	H_3BO_3	226,000	161,830	161,830	6	2
(*Daphnia magna*)	LC50	48	S,M	85	$Na_2B_4O_7$	141,000				3
	LC50	48	S,U	148	H_3BO_3	133,000				4
Razorback Sucker	LC50	96	S,U	233-330	H_3BO_3	233,000	254,965	254,965	7	5
(*Xyrauchen texanus*)	LC50	96	S,U	233-330	H_3BO_3	279,000				5
Annelid	LC50	96	S,M	110-135	H_3BO_3	261,000	269,366	269,366	8	6
(*Lumbriculus variegatus*)	LC50	96	S,M	110-135	H_3BO_3	278,000				6
Colorado Squawfish	LC50	96	S,U	233-330	H_3BO_3	279,000	383,499	383,449	9	5
(*Ptychocheilus lucius*)	LC50	96	S,U	233-330	H_3BO_3	527,000				5
Bonytail	LC50	96	S,U	233-330	H_3BO_3	280,000	393,141	393,141	10	5
(*Gila elegans*)	LC50	96	S,U	233-330	H_3BO_3	552,000				5
Fingernail clam *(Sphaerium simile)*	LC50	96	S,M	102	H_3BO_3 and $Na_2B_4O_7$	>447,000	447,000	447,000	11	10
Winter Stonefly *(Allocapnia vivipara)*	LC50	96	S,M	98	H_3BO_3 and $Na_2B_4O_7$	476,000	476,000	476,000	12	10
Washboard *(Megalonaias nervosa)*	LC50	96	S,M	88	H_3BO_3 and $Na_2B_4O_7$	>544,000	544,000	544,000	13	10
Chinook Salmon	LC50	96	S,U	211	H_3BO_3	725,000	800,366	598,133	14	7
(*Oncorhynchus tschawytscha*	LC50	96	S,U	41.7	H_3BO_3	566,000				7
	LC50	96	S,U	41.7	H_3BO_3	>1,000,000[16]				7
	LC50	96	S,U	41.7	H_3BO_3	>1,000,000[16]				7

ACUTE DATA (Continued)

Species	Test type (EC or LC50)	Duration (hours)	Test conditions (FT,M, etc.)	Hardness mg/L	Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Coho Salmon (*Oncorhynchus kisutch*)	LC50	96	S,U	211	H_3BO_3	447,000	447,000			7
Midge	LC50	48	S,M	110-135	H_3BO_3	1,503,000	1,296,309	1,335,560	15	6
(*Chironomus tentans*)	LC50	48	S,M	110-135	H_3BO_3	1,503,000				6
	LC50	48	S,U	115	H_3BO_3	964,290				8
Midge (*Chronomus decorus*)	LC50	48	S,U	85	$Na_2B_4O_7$	1,376,000	1,376,000			3
Brown Planarian (*Dugesia tigrina*)	LC50	96	SR,M	32	H_3BO_3	1,357,720	1,357,720	1,357,720	16	1

CHRONIC DATA

Species	Test type (ELS, etc.)	Duration (days)	Study Conditions (FT,M etc.)	Hardness mg/L	Chemical	MATC ug/L	SMCV ug/L	GMCV ug/L	Rank	Reference
Amphipod (*Hyalella azteca*)	LC	42	SR,M	100	H_3BO_3 and $Na_2B_4O_7$	9,300	9,300	9,300	1	10
Water Flea (*Daphnia magna*)	LC	21	SR,M	148	H_3BO_3	9,330	9,330	9,330	2	4
Fathead Minnow	LSG	7	SR,M	60	H_3BO_3	14,100	15,020	15,020	3	1
(*Pimephales promelas*)	ELS	32	SR,M	100	H_3BO_3 and $Na_2B_4O_7$	16,000				10

Notes

* Value rounded to 2 significant figures.

[1] Hardness values given for all tests; if alkalinity value available, given after hardness as hardness/alkalinity

[2] Results from tests of pH effect on toxicity. Test series included pH-unmodified waters, and waters with pH modified by carbon dioxide atmosphere. Carbon dioxide-modified water test results not used because carbon dioxide treatments may have compromised test organism performance, based on poor control performance. Reported values are for tests in waters without carbon dioxide treatment.

[3] Results from tests of chlorides effects on toxicity (inconclusive).

[4] Results from tests of sulfates effects on toxicity (inconclusive).

[5] Results from tests of dissolved organic carbon effects on toxicity (inconclusive).

[6] Results from tests of effect of boron compound type on toxicity.

[7] Results from tests of hardness effect on toxicity.

[8] Results from tests of pH effects on toxicity; pH 6.6.

[9] Results from tests of pH effects on toxicity; pH 7.6.

[10] Results from tests of pH effects on toxicity; pH 8.4.

[11] Results from tests of waters with chloride and hardness covarying.

[12] Results from tests of waters with hardness varying (via Ca and Mg SO_4 addition) but chloride constant.

[13] Results from tests of pH effects on toxicity; pH 6.6.

[14] Results from tests of pH effects on toxicity; pH 7.6.

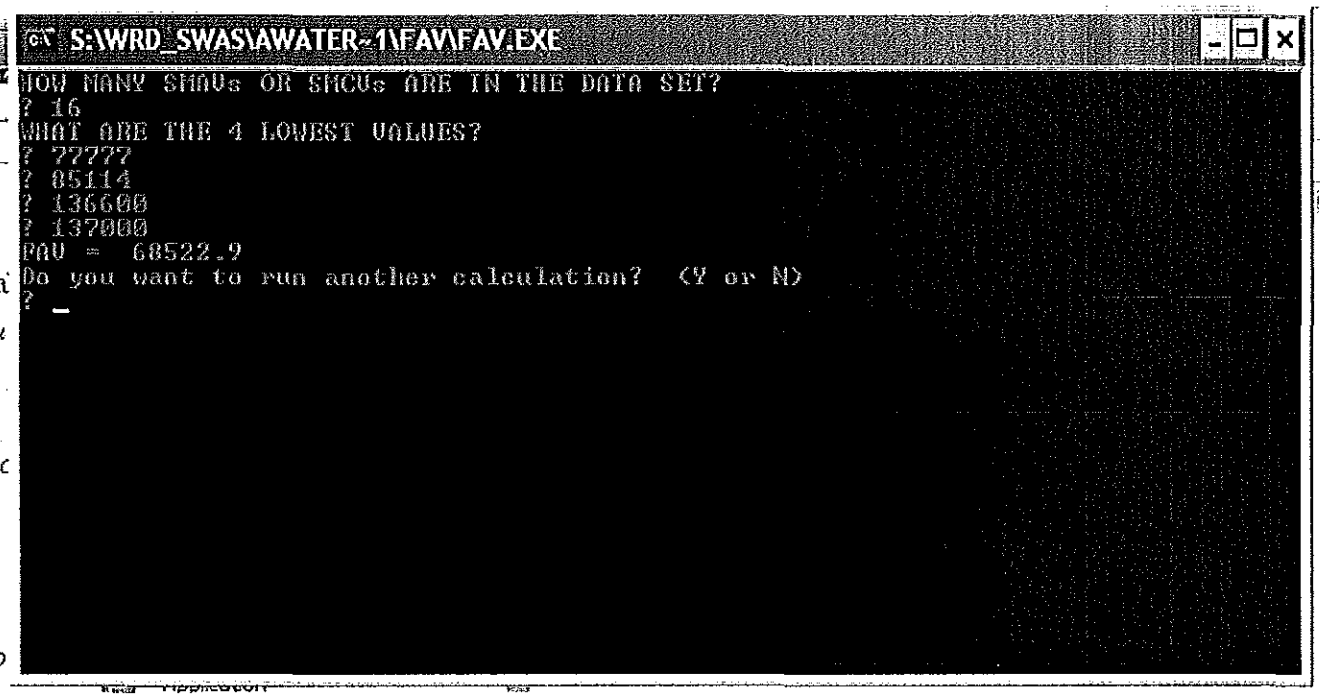
[15] Results from tests of pH effects on toxicity; pH 8.4.

[16] Values not used in previous review. However, this review considers the "greater than" data points to reliably establish a minimum LC50, and therefore uses the values for GMAV development.

References Used:
1. #019013: Sanders and Associates, LLC. 2007. Toxicity of boron to the aquatic organisms—*Hyalella azteca* (benthic crustacean), *Dugesia tigrina* (flatworm); *Ceriodaphnia dubia* (water flea) and *Pimephales promelas* (fathead minnow). Report to Michigan Department of Environmental Quality. April 30, 2007.
2. #008973: Lewis, M.A.; and L.C. Valentine. 1981. Acute and chronic toxicities of boric acid to *Daphnia magna* Straus. Bull. Environ. Contam. Toxicol. 27: 304-315.
3. #014096: Maier, K.J.; and A.W. Knight. 1991. The toxicity of waterborne boron to *Daphnia magna* and *Chironomus decorus* and the effects of water hardness and sulfate on boron toxicity. Arch. Environ. Contam. Toxicol. 20: 282-287.
4. #ATL0003: Gersich, F.M. 1984. Evaluation of static renewal chronic toxicity test method for *Daphnia magna* Straus using boric acid. Environ. Toxicol. Chem. 3: 89-94.
5. #014544: Hamilton, S. 1995. Hazard assessment of inorganics to three endangered fish in the Green River, Utah. Ecotoxicol. Environ. Saf. 30: 134-142.
6. #015445: Sanders, D. 1998. Tier II boron value data supplement. Rept., RMT Applied Biology, Appleton, WI. August 7, 1998.
7. #014097: Hamilton, S.; and K. Buhl. 1990. Acute toxicity of boron, molybdenum, and selenium to fry of Chinook Salmon and Coho Salmon. Arch. Environ. Contam. Toxicol. 19: 366-373.
8. #015444: Sanders, D. 1999. Tier II boron value data supplement. Rept., RMT Applied Biology, Appleton, WI. February 15, 1999.
9. Dethloff, G.M., W.M Stubblefield, and C.E.Schlekat. 2009. Effects of water quality parameters on boron toxicity to *Ceriodaphnia dubia*. Arch. Environ. Contam. Toxicol. 57:60-67.
10. Soucek, D.J., A. Dickinson, and B.T. Koch. 2011. Acute and chronic toxicity of boron to a variety of freshwater organisms. Environ. Toxicol. Chem. 30(8): 1906-1914.

References Reviewed, but not used
Kanabur, V.V. and D. Sannadurgappa. 2001. Acute toxicity of phenol and cresol to a freshwater fish. Environ. Ecol. 19(4):756-758.

From FAV
11/22/11 B. Dimond



Min. data req. met	Acute Factor
2	13
3	8
4	7
5	6.1
6	5.2
7	4.3

Rule 57 Aquatic Values Work Sheet

*Chemical Name:*_Boron_____
*C.A.S. #:*_7440-42-8_____

AQUATIC MAXIMUM VALUE CALCULATIONS

A. Minimum 8 species requirement is **not** met. Minimum requirements met = **_n/a__**
Minimum requirements missing for Tier I =
Acute factor = ____

1. Toxicity **is not** dependent on a water characteristic

   a. FAV calculation

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table ___)

   b. FAV equation:

3. Go to C.

B. Minimum 8 species requirement **is** met (Tier I)

1. Toxicity **is not** dependent on a water characteristic

   a. FAV calculation: 68,522.9 ug/l (see attached) round to 69,000 ug/l

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table ___)

   b. Ranked genus mean acute intercepts: Table

   c. Final acute intercept = (Att. ___)

   ln of final acute intercept =

   d. FAV equation =

C. Aquatic Maximum Value (AMV) calculation:
68,522.9/2 = 34261.45 round to 34,000 ug/l

FINAL CHRONIC VALUE CALCULATIONS

A. Minimum 8 species requirement is **not** met (Tier II). Minimum requirements met = _3_
Minimum requirements missing for Tier I =

1. Acute to chronic ratio

   a. Number ACRs meeting minimum data requirements = _3__ (Table ___)

   b. Acute to chronic ratio = 9.470010106

2. Toxicity **is not** dependent on a water characteristic

   FCV = 68522.9/9.470010106 = 7235.778973, round to 7,200 ug/l

3. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table _)

   b. Aquatic chronic intercept = (Table _)

   ln of aquatic chronic intercept =

   c. FCV equation =

B. Minimum 8 species requirement **is** met (Tier I)

1. Toxicity **is not** dependent on a water characteristic

   a. FCV = ___ (Att. ___)

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table _)

   b. Ranked genus mean chronic intercepts: Table ___

   c. Final chronic intercept = ____ (Att. ___); ln of final chronic intercept =

   d. FCV equation =

Table 1. Boron ACR Values Calculations 11/22/2011

Species	Reference	LC50	MATC	ACR	SMACR
Hyalella azteca [1]	10	107,000	9,300	11.505376	11.50538
Daphnia magna	4	133,000	9,330	14.255091	14.25509
Pimephales promelas	1	75,900	14,100	5.3829787	5.17822
	10	79,700	16,000	4.98125	

Final ACR is cube root of the SMACRs = 9.470010106

[1] *H. azteca* LC50 and MATC generated in 100b water.