# APPENDIX E

## BCF VALUES FOR COMMUNITY MEASURMENT RECEPTORS
**from Appendix C of EPA, 1999b**

## APPENDIX C

## MEDIA-TO-RECEPTOR *BCF*s

Appendix C provides recommended guidance for determining values for media-to-receptor bioconcentration factors (*BCF*s) based on values reported in the scientific literature, or estimated using physical and chemical properties of the compound. Guidance on use of *BCF* values in the screening level ecological risk assessment is provided in Chapter 5.

Section C-1.0 provides the general guidance recommended to select or estimate *BCF* values. Sections C-1.1 through C-1.7 further discuss determination of *BCF*s for specific media and receptors. References cited in Sections C-1.1 through C-1.7 are located following Section C-1.7.

For the compounds commonly identified in risk assessments for combustion facilities (identified in Chapter 2), *BCF* values have been determined following the guidance in Sections C-1.1 through C-1.7. *BCF* values for these limited number of compounds are included in this appendix in Tables C-1 through C-7 to facilitate the completion of screening ecological risk assessments. However, it is expected that additional compounds may require evaluation on a site specific basis, and in such cases, *BCF* values for these additional compounds could be determined following the same guidance (Sections C-1.1 through C-1.7) used in determination of the *BCF* values reported in this appendix. For reproducibility and to facilitate comparison of new data and values as they become available, all data reviewed in the selection of the *BCF* values provided at the end of this appendix are also included in Tables C-1 through C-7. References cited in Tables C-1 through C-7 (Media-to-Receptor *BCF* Values) are located following Table C-7.

For additional discussion on some of the references and equations cited in Sections C-1.1 through C-1.7, the reader is recommended to review the Human Health Risk Assessment Protocol (HHRAP) (U.S. EPA 1998) (see Appendix A-3), and the source documents cited in the reference section of this appendix.

### C-1.0 GENERAL GUIDANCE

This section summarizes the recommended general guidance for determining compound-specific *BCF* values (media-to-receptors) provided in Tables C-1 through C-7. As a preference, *BCF* values were selected from empirical field and/or laboratory data generated from reviewed studies that are published in the scientific literature. Information used from these studies included calculated *BCF* values, as well as, collocated media and organism concentration data from which *BCF* values could be calculated. If two or more *BCF* values, or two or more sets of collocated data, were available in the published scientific literature, the geometric mean of the values was used.

Field-derived *BCF* values were considered more indicative of the level of bioconcentration occurring in the natural environment than laboratory-derived values. Therefore, when available and appropriate, field-derived *BCF* values were given priority over laboratory-derived values. In some cases, confidence in the methods used to determine or report field-derived *BCF* values was less than for the laboratory-derived values. In those cases, the laboratory-derived values were used for the recommended *BCF* values.

When neither field or laboratory data were available for a specific compound, data from a potential surrogate compound were evaluated. The appropriateness of the surrogate was determined by comparing the structures of the two compounds. Where an appropriate surrogate was not identified, a regression equation based on the compound's log $K_{ow}$ value was used to calculate the recommended *BCF* value.

With the exception of the air-to-plant biotransfer factors (*Bv*), recommended *BCF* values provided in the tables at the end of this appendix are based on wet tissue weight and dry media weight (except for water). As necessary, reported values were converted to these units using the referenced tissue or media wet weight percentages. The conversion factors, equations, and references for these conversions are discussed in Sections C-1.1 through C-1.7 where appropriate, and are presented at the end of each table (Tables C-1 through C-7).

### C-1.1 SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS

Soil-to-soil invertebrate *BCF* values (see Table C-1) were developed mainly from data for earthworms. Measured experimental results were primarily in the form of ratios of compound concentrations in a earthworm and the compound concentrations in the soil in which the earthworm was exposed. As necessary, values were converted to wet tissue and dry media weight assuming a moisture content (by mass) of 83.3 percent for earthworms and 20 percent for soil (Pietz et al. 1984).

*Organics* For organic compounds with no field or laboratory data available, recommended *BCF* values were estimated using the following regression equation:

$$\log BCF = 0.819 \log K_{ow} - 1.146 \qquad \text{Equation C-1-1}$$

- Southworth, G.R., J.J. Beauchamp, and P.K. Schmieder. 1978. "Bioaccumulation Potential of Polycyclic Aromatic Hydrocarbons in *Daphnia Pulex." Water Research.* Volume 12. Pages 973-977.

*Inorganics* For inorganic compounds with no field or laboratory data available, the recommended *BCF* value is equal to the arithmetic average of the available *BCF* values for other inorganics as specified in Table C-1.

### C-1.2 SOIL-TO-PLANT AND SEDIMENT-TO-PLANT BIOCONCENTRATION FACTORS

Soil-to-plant *BCF* values (see Table C-2) account for plant uptake of compounds from soil. Data for a variety of plants and food crops were used to determine recommended *BCF* values.

*Organics* For all organics (including PCDDs and PCDFs) with no available field or laboratory data, the following regression equation was used to calculate recommended values:

$$\log BCF = 1.588 - 0.578 \log K_{ow} \qquad \text{Equation C-1-2}$$

- Travis, C.C. and A.D. Arms. 1988. "Bioconcentration of Organics in Beef, Milk, and Vegetation." *Environmental Science and Technology.* 22:271-274.

*Inorganics* For most metals, *BCF* values were based on empirical data reported in the following:

- Baes, C.F., R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. "Review and Analysis of Parameters and Assessing Transport of Environmentally Released Radionuclides Through Agriculture." Oak Ridge National Laboratory, Oak Ridge, Tennessee.

The scientific literature also was searched to identify studies. Although U.S. EPA (1995a) provides values for certain metals calculated on the basis of plant uptake response slope factors, it is unclear how the *BCF*

values were calculated or which sources or references were used. Therefore, values reported in U.S. EPA (1995a) were not used.

### C-1.3 WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS

Experimental data for crustaceans, aquatic insects, bivalves, and other aquatic invertebrates were used to determine recommended *BCF* values for water-to-aquatic invertebrate (see Table C-3). Both marine and freshwater exposures were reviewed. As necessary, available results were converted to wet tissue weight assuming that invertebrate moisture content (by mass) is 83.3 percent (Pietz et al. 1984).

*Organics* Reported field values for organic compounds were assumed to be total compound concentrations in water and, therefore, were converted to dissolved compound concentrations in water using the following equation from U.S. EPA (1995b):

$$BCF\ (\text{dissolved}) = (BCF\ (\text{total}) / f_{fd}) - 1 \qquad \text{Equation C-1-3}$$

where

| | | |
|---|---|---|
| *BCF* (dissolved) | = | *BCF* based on dissolved concentration of compound in water |
| *BCF* (total) | = | BCF based on the field derived data for total concentration of compound in water |
| $f_{fd}$ | = | Fraction of compound that is freely dissolved in the water |

and,

| | | |
|---|---|---|
| $f_{fd}$ | = | $1 / [1 + ((DOC \times K_{ow}) / 10) + (POC \times K_{ow})]$ |
| *DOC* | = | Dissolved organic carbon, kilograms of organic carbon / liter of water ($2.0 \times 10^{-06}$ Kg/L) |
| $K_{ow}$ | = | Octanol-water partition coefficient of the compound, as reported in U.S. EPA (1994a) |
| *POC* | = | Particulate organic carbon, kilograms of organic carbon / liter of water ($7.5 \times 10^{-09}$ Kg/L) |

Laboratory data were assumed to be based on dissolved compound concentrations.

For organic compounds with no field or laboratory data available, *BCF* values were determined from surrogate compounds or calculated using the following regression equation:

$$log\ BCF = 0.819 \times log\ K_{ow} - 1.146 \qquad \text{Equation C-1-4}$$

- Southworth, G.R., J.J. Beauchamp, and P.K. Schmieder. 1978. "Bioaccumulation Potential of Polycyclic Aromatic Hydrocarbons in *Daphnia Pulex.*" *Water Research.* Volume 12. Pages 973-977.

*Inorganics* For inorganic compounds with no field or laboratory data available, the recommended *BCF* values were estimated as the arithmetic average of the available *BCF* values for other inorganics, as specified in Table C-3.

## C-1.4 WATER-TO-ALGAE BIOCONCENTRATION FACTORS

Experimental data for both marine and freshwater algal species were reviewed. As necessary, available results were converted to wet tissue weight assuming that algae moisture content (by mass) is 65.7 percent (Isensee et al. 1973).

*Organics* For organic compounds with no field or laboratory data available, *BCF* values were calculated using the following regression equation:

$$log\ BCF = 0.819 \times log\ K_{ow} - 1.146 \qquad \text{Equation C-1-5}$$

- Southworth, G.R., J.J. Beauchamp, and P.K. Schmieder. 1978. "Bioaccumulation Potential of Polycyclic Aromatic Hydrocarbons in *Daphnia Pulex." Water Research.* Volume 12. Pages 973-977.

*Inorganics* For inorganics, available field or laboratory data were evaluated for each compound.

## C-1.5 WATER-TO-FISH BIOCONCENTRATION FACTORS

Experimental data for a variety of marine and freshwater fish were used to determine recommended *BCF* values (see Table C-5). As necessary, values were converted to wet tissue weight assuming that fish moisture content (by mass) is 80.0 percent (Holcomb et al. 1976).

For both organic and inorganic compounds, reported field values were considered bioaccumulation factors (*BAF*s) based on contributions of compounds from food sources as well as media. Therefore, field values were converted to *BCF*s based on the trophic level of the test organism using the following equation:

$$BCF = (BAF_{TLn} / FCM_{TLn}) - 1 \qquad \text{Equation C-1-6}$$

where

$BAF_{TLn}$ = The reported field bioaccumulation factor for the trophic level "n" of the study species.

$FCM_{TLn}$ = The food chain multiplier for the trophic level "n" of the study species.

*Organics* Reported field values for organic compounds were assumed to be total compound concentrations in water and, therefore, were converted to dissolved compound concentrations in water using the following equation from U.S. EPA (1995b):

$$BAF\ (\text{dissolved}) = (BAF\ (\text{total}) / f_{fd}) - 1 \qquad \text{Equation C-1-7}$$

where

$BAF$ (dissolved) = *BAF* based on dissolved concentration of compound in water

$BAF$ (total) = *BAF* based on the field derived data for total concentration of compound in water

$f_{fd}$ = Fraction of compound that is freely dissolved in the water

and,

| | | |
|---|---|---|
| $f_{fd}$ | = | $1 / [1 + ((DOC \times K_{ow}) / 10) + (POC \times K_{ow})]$ |
| $DOC$ | = | Dissolved organic carbon, Kg of organic carbon / L of water ($2.0 \times 10^{-06}$ Kg/L) |
| $K_{ow}$ | = | Octanol-water partition coefficient of the compound, as reported in U.S. EPA (1994a) |
| $POC$ | = | Particulate organic carbon, Kg of organic carbon / L of water ($7.5 \times 10^{-09}$ Kg/L) |

Laboratory data were assumed to be based on dissolved compound concentrations.

For organics for which no field or laboratory data were available, the following regression equation was used to calculate the recommended *BCF* values:

$$log\ BCF = 0.91 \times log\ K_{ow} - 1.975 \times log\ (6.8E\text{-}07 \times K_{ow} + 1.0) - 0.786 \qquad \text{Equation C-1-8}$$

- Bintein, S., J. Devillers, and W. Karcher. 1993. "Nonlinear Dependence of Fish Bioconcentrations on n-Octanol/Water Partition Coefficients." *SAR and QSAR in Environmental Research.* Vol. 1. Pages 29-39.

*Inorganics* For inorganic compounds with no available field or laboratory data, the recommended *BCF* values were estimated as the arithmetic average of the available *BCF* values reported for other inorganics.

## C-1.6 SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS

Experimental data for a variety of benthic infauna, worms, insects, and other invertebrates were used to determine the recommended *BCF* values for sediment-to-benthic invertebrate (see Table C-6). As necessary, values were converted to wet tissue weight assuming that benthic invertebrate moisture content (by mass) is 83.3 percent (Pietz et al. 1984).

*Organics* For organic compound (including PCDDs and PCDFs) with no available field or laboratory data, the recommended *BCF* values were determined using the following regression equation:

$$log\ BCF = 0.819 \times log\ K_{ow} - 1.146 \qquad \text{Equation C-1-9}$$

- Southworth, G.R., J.J. Beauchamp, and P.K. Schmieder. 1978. "Bioaccumulation Potential of Polycyclic Aromatic Hydrocarbons in *Daphnia Pulex.*" *Water Research.* Volume 12. Pages 973-977.

*Inorganics* For inorganic compound with no available field or laboratory data, the recommended *BCF* values were estimated as the arithmetic average of the available *BCF* values for other inorganics.

## C-1.7 AIR-TO-PLANT BIOCONCENTRATION FACTORS

The air-to-plant bioconcentration (*Bv*) factor (see Table C-7) is defined as the ratio of compound concentrations in exposed aboveground plant parts to the compound concentration in air. Bv values in Table C-7 are reported on dry-weight basis since the plant concentration equations (see Chapter 3) already include a dry-weight to wet-weight conversion factor.

*Organics* For organics (excluding PCDDs and PCDFs), the air-to-plant bioconcentration factor was calculated using regression equations derived for azalea leaves in the following documents:

- Bacci E., D. Calamari, C. Gaggi, and M. Vighi. 1990. "Bioconcentration of Organic Chemical Vapors in Plant Leaves: Experimental Measurements and Correlation." *Environmental Science and Technology.* Volume 24. Number 6. Pages 885-889.

- Bacci E., M. Cerejeira, C. Gaggi, G. Chemello, D. Calamari, and M. Vighi. 1992. "Chlorinated Dioxins: Volatilization from Soils and Bioconcentration in Plant Leaves." *Bulletin of Environmental Contamination and Toxicology.* Volume 48. Pages 401-408.

Bacci et al. (1992) developed a regression equation using empirical data collected for the uptake of 1,2,3,4-TCDD in azalea leaves and data obtained from Bacci et al. (1990). The bioconcentration factor obtained was included in a series of 14 different organic compounds to develop a correlation equation with $K_{ow}$ and $H$ (defined below). Bacci et al. (1992) derived the following equations:

$$log\ B_{vol} = 1.065\ log\ K_{ow} - log\ (\frac{H}{RT}) - 1.654 \qquad (r = 0.957) \qquad \text{Equation C-1-10}$$

$$Bv = \frac{\rho_{air} \cdot B_{vol}}{(1 - f_{water}) \cdot \rho_{forage}} \qquad \text{Equation C-1-11}$$

where

| | | |
|---|---|---|
| $B_{vol}$ | = | Volumetric air-to-plant biotransfer factor (fresh-weight basis) |
| $Bv$ | = | Air-to-plant biotransfer factor (dry-weight basis) |
| $\rho_{air}$ | = | 1.19 g/L (Weast 1986) |
| $\rho_{forage}$ | = | 770 g/L (Macrady and Maggard 1993) |
| $f_{water}$ | = | 0.85 (fraction of forage that is water—Macrady and Maggard [1993]) |
| $H$ | = | Henry's Law constant (atm-m$^3$/mole) |
| $R$ | = | Universal gas constant (atm-m$^3$/mole °K) |
| $T$ | = | Temperature (25°C, 298°K) |

Equations C-1-10 and C-1-11 are used to calculate $Bv$ values (see Table C-7) using the recommended values of $H$ and $K_{ow}$ provided in Appendix A at a temperature ($T$) of 25 °C or 298.1 K. The following uncertainty should be noted with use of $Bv$ values calculated using these equations:

- For organics (except PCDDs and PCDFs), U.S. EPA (1993) recommended that *Bv* values be reduced by a factor of 10 before use. This was based on the work conducted by U.S. EPA (1993) for U.S. EPA (1994b) as an interim correction factor. Welsch-Pausch, McLachlan, and Umlauf (1995) conducted experiments to determine concentrations of PCDDs and PCDFs in air and resulting biotransfer to welsh ray grass. This was documented in the following:

  - Welsch-Pausch, K.M. McLachlan, and G. Umlauf. 1995. "Determination of the Principal Pathways of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans to Lolium Multiflorum (Welsh Ray Grass)". *Environmental Science and Technology*. 29: 1090-1098.

  A follow-up study based on Welsch-Pausch, McLachlan, and Umlauf (1995) experiments was conducted by Lorber (1995) (see discussion below for PCDDs and PCDFs). In a following publication, Lorber (1997) concluded that the Bacci factor reduced by a factor of 100 was close in line with observations made by him through various studies, including the Welsch-Pausch, McLachlan, and Umlauf (1995) experiments. Therefore, this guidance recommends that *Bv* values be calculated using the Bacci, Cerejeira, Gaggi, Chemello, Calamari, and Vighi (1992) correlation equations and then reduced by a factor of 100 for all organics, excluding PCDDs and PCDFs.

***PCDDs and PCDFs*** For PCDDs and PCDFs, *Bv* values, on a dry weight basis, were obtained from the following:

- Lorber, M., and P. Pinsky. 1999. "An Evaluation of Three Empirical Air-to-Leaf Models for Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans." National Center for Environmental Assessment (NCEA). U. S. EPA, 401 M St. SW, Washington, DC. *Accepted for Publication in Chemosphere.*

U.S. EPA (1993) stated that, for dioxin-like compounds, the use of the Bacci, Cerejeira, Gaggi, Chemello, Calamari, and Vighi (1992) equations may overpredict *Bv* values by a factor of 40. This was because the Bacci, Calamari, Gaggi, and Vighi (1990) and Bacci, Cerejeira, Gaggi, Chemello, Calamari, and Vighi (1992) experiments did not take photodegradation effects into account. Therefore, *Bv* values calculated using Equations C-10 and C-11 were recommended to be reduced by a factor of 40 for dioxin-like compounds.

However, according to Lorber (1995), the Bacci algorithm divided by 40 may not be appropriate because (1) the physical and chemical properties of dioxin congeners are generally outside the range of the 14 organic compounds used by Bacci, Calamari, Gaggi, and Vighi (1990), and (2) the factor of 40 derived from one experiment on 2,3,7,8-TCDD may not apply to all dioxin congeners.

Welsch-Pausch, McLachlan, and Umlauf (1995) conducted experiments to obtain data on uptake of PCDDs and PCDFs from air to *Lolium Multiflorum* (Welsh Ray grass). The data includes grass concentrations and air concentrations for dioxin-congener groups, but not the invidual congeners. Lorber (1995) used data from Welsch-Pausch, McLachlan, and Umlauf (1995) to develop an air-to-leaf transfer factor for each dioxin-congener group. *Bv* values developed by Lorber (1995) were about an order of magnitude less than values that would have been calculated using the Bacci, Calamari, Gaggi, and Vighi (1990; 1992) correlation equations. Lorber (1995) speculated that this difference could be attributed to several factors including experimental design, climate, and lipid content of plant species used.

Lorber (1999) conducted an evaluation of three empirical air-to-leaf models for estimating grass concentraions of PCDDs and PCDFs from air concentrations of these compounds described and tested against field data. *Bv* values recommended for PCDDs and PCDFs in this guidance were obtained from the experimentally derived values of Lorber (1999).

***Metals*** For metals, no literature sources were available for *Bv* values. U.S. EPA (1995a) quoted from the following document, that metals were assumed not to experience air to leaf transfer:

- Belcher, G.D., and C.C. Travis. 1989. "Modeling Support for the RURA and Municipal Waste Combustion Projects: Final Report on Sensitivity and Uncertainty Analysis for the Terrestrial Food Chain Model." Interagency Agreement No. 1824-A020-A1. Office of Risk Analysis, Health and Safety Research Division. Oak Ridge National Laboratory. Oak Ridge, Tennessee. October.

Consistent with the above references, *Bv* values for metals (excluding elemental mercury) were assumed to be zero (see Table C-7).

***Mercuric Compounds*** Mercury emissions are assumed to consist of both the elemental and divalent forms. However, only small amounts of elemental mercury is assumed to be deposited (see Chapter 2). Elemental mercury either dissipates into the global cycle or is converted to the divalent form. Methyl mercury is assumed not to exist in the stack emissions or in the air phase. Consistent with various discussions in Chapter 2 concerning mercury, (1) elemental mercury reaching or depositing onto the plant surfaces is negligible, and (2) biotransfer of methyl mercury from air is zero. This is based on assumptions made regarding speciation and fate and transport of mercury from stack emissions. Therefore, the *Bv* value for (1) elemental mercury was assumed to be zero, and (2) methyl mercury was assumed not to be applicable. *Bv* values for mercuric chloride (dry weight basis) were obtained from U.S. EPA (1997).

It should be noted that uptake of mercury from air into the aboveground plant tissue is primarily in the divalent form. A part of the divalent form of mercury is assumed to be converted to the methyl mercury form once in the plant tissue.

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## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 15Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-tetrachlorodibenzo-p-dioxin | | | Recommended BCF Value: 1.59 |
| The BCF was calculated using the geometric mean of 5 laboratory values for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as follows: | | | |
| 14.5 | Martinucci, Crespi, Omodeo, Osella, and Traldi (1983) | 20-day exposure | Not specified |
| 9.41 0.64<br>0.68 0.17 | Reinecke and Nash (1984) | 20-day exposure | *Allolobaphora caliginosa*<br>*Lumbricus rubellus* |
| Compound: 1,2,3,7,8-pentachlorodibenzo-p-dioxin | | | Recommended Value: 1.46 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.92 =1.46 | | | |
| Compound: 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin | | | Recommended Value: 0.49 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.31 =0.49 | | | |
| Compound: 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin | | | Recommended Value: 0.19 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.12 = 0.19 | | | |
| Compound: 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin | | | Recommended Value: 0.22 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.14 = 0.22 | | | |
| Compound: 1,2,3,4,6,7,8,-heptachlorodibenzo-p-dioxin | | | Recommended Value: 0.081 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.051 = 0.081 | | | |
| Compound: Octachlorodibenzo-p-dioxin | | | Recommended Value: 0.019 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.012 = 0.019 | | | |
| Compound: 2,3,7,8-tetrachlorodibenzofuran | | | Recommended BCF Value: 1.27 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.80 =1.27 | | | |
| Compound: 1,2,3,7,8-pentachlorodibenzofuran | | | Recommended BCF Value: 0.32 |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 16Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.22 = 0.32 | | | |
| Compound: 2,3,4,7,8-pentachlorodibenzofuran | | | Recommended BCF Value: 2.54 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 1.6 =2.54 | | | |
| Compound: 1,2,3,4,7,8-hexachlorodibenzofuran | | | Recommended BCF Value: 0.121 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.076 = 0.121 | | | |
| Compound: 1,2,3,6,7,8-hexachlorodibenzofuran | | | Recommended BCF Value: 0.30 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.19 = 0.30 | | | |
| Compound: 2,3,4,6,7,8-hexachlorodibenzofuran | | | Recommended BCF Value: 1.07 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.67 =1.07 | | | |
| Compound: 1,2,3,7,8,9-hexachlorodibenzofuran | | | Recommended BCF Value: 1.00 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.63 = 1.00 | | | |
| Compound: 1,2,3,4,6,7,8-heptachlorodibenzofuran | | | Recommended BCF Value: 0.017 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.011 = 0.017 | | | |
| Compound: 1,2,3,4,7,8,9-heptachlorodibenzofuran | | | Recommended BCF Value: 0.62 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.39 = 0.62 | | | |
| Compound: Octochlorodibenzofuran | | | Recommended BCF Value: 0.025 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1.59 x 0.016 = 0.025 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF Value: 0.07 |
| The BCF was calculated using the geometric mean of 6 laboratory values for benzo(a)pyrene. The values reported in Rhett, Simmers, and Lee (1988) were converted to earthworm wet weight over soil dry weight using a conversion factor of 5.99[a]. | | | |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 17Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| 0.12 0.14<br>0.05 0.04<br>0.06 0.06 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| Compoound: Benzo(a)anthracene | | | Recommended BCF Value: 0.03 |
| The BCF was calculated using the geometric mean of 15 values for benzo(a)anthracene. The values reported in Marquenie, Simmers, and Kay (1987) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.07 0.02<br>0.08 0.02<br>0.05 0.07<br>0.07 0.003<br>0.07 0.05<br>0.02 0.01<br>0.01 0.01<br>0.09 | Marquenie, Simmers, and Kay (1987) | 32-day exposure | *Eisenia foetida* |
| Compound: Benzo(b)fluoranthene | | | Recommended BCF Value: 0.07 |
| The BCF was calculated using the geometric mean of 6 laboratory values for benzo(b)fluoranthene. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.11 0.16<br>0.06 0.04<br>0.06 0.05 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF Value: 0.08 |
| The BCF was calculated using the geometric mean of 15 laboratory values for benzo(k)fluoranthene. The values reported in Marquenie, Simmers, and Kay (1987) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.13 0.15<br>0.12 0.11<br>0.07 0.24<br>0.12 0.02<br>0.10 0.03<br>0.07 0.03<br>0.06 0.04 | Marquenie, Simmers, and Kay (1987) | 32-day exposure | *Eisenia foetida* |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 18Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Chrysene | | | Recommended BCF Value: 0.04 |
| The BCF was calculated using the geometric mean of 15 laboratory values for chrysene. The values reported in Marquenie, Simmers, and Kay (1987) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.06 0.03<br>0.09 0.04<br>0.09 0.07<br>0.14 0.007<br>0.14 0.02<br>0.04 0.02<br>0.03 0.01<br>0.10 | Marquenie, Simmers, and Kay (1987) | 32-day exposure | *Eisenia foetida* |
| Compound: Dibenzo(a,h)anthracene | | | Recommended BCF Value: 0.07 |
| The BCF was calculated using the geometric mean of 15 laboratory values for Dibenz(a,h)anthrcene. The values reported in Marquenie, Simmers, and Kay (1987) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.18 0.13<br>0.10 0.06<br>0.06 0.07<br>0.04 0.10<br>0.12 0.05<br>0.07 0.04<br>0.04 0.05<br>0.05 | Marquenie, Simmers, and Kay (1987) | 32-day exposure | *Eisenia foetida* |
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF Value: 0.08 |
| The BCF was calculated using the geometric mean of 6 laboratory values for indeno(1,2,3-cd)pyrene. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.07 0.13<br>0.08 0.09<br>0.06 0.05 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF Value: 1.13 |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 19Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the geometric mean of 7 laboratory values for a mixture of PCB congeners. The values reported in Rhett, Simmers, and Lee (1988) and Kreis, Edwards, Cuendet, and Tarradellas (1987) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 1.43 0.81<br>0.75 1.07<br>1.17 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 1.92<br>1.16 | Kreis, Edwards, Cuendet, and Tarradellas (1987) | Chronic exposure | *Nicodrilus* sp. |
| Compound: Aroclor 1254 | | | Recommended BCF Value: 1.13 |
| The BCF was calculated using the geometric mean of 7 laboratory values for a mixture of PCB congeners. The values reported in Rhett, Simmers, and Lee (1988) and Kreis, Edwards, Cuendet, and Tarradellas (1987) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 1.43 0.81<br>0.75 1.07<br>1.17 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 1.92<br>1.16 | Kreis, Edwards, Cuendet, and Tarradellas (1987) | Chronic exposure | *Nicodrilus* sp. |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 20Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF Value: 1.19 |
| No empirical data were available for 1,3-dinitrobenzene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.491 (U.S. EPA 1994b). | | | |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF Value: 3.08 |
| No empirical data were available for 2,4-dinitrotoluene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.996 (U.S. EPA 1994b). | | | |
| Compound: 2,6-Dinitrotoluene | | | Recommended BCF Value: 2.50 |
| No empirical data were available for 2,6-dinitrotoluene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.886 (U.S. EPA 1994b). | | | |
| Compound: Nitrobenzene | | | Recommended BCF Value: 2.26 |
| No empirical data were available for nitrobenzene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.833 (U.S. EPA 1994b). | | | |
| Compound: Pentachloronitrobenzene | | | Recommended BCF Value: 451 |
| No empirical data were available for pentachloronitrobenzene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 4.640 (U.S. EPA 1994b). | | | |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF Value: 1,309 |
| No empirical data were available for bis(2-ethylhexyl)phthalate or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 5.205 (U.S. EPA 1994b). | | | |
| Compound: Di(n)octyl phthalate | | | Recommended BCF Value: 3,128,023 |
| No empirical data were available for di(n)octyl phthalate or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 9.330 (U.S. EPA 1994b). | | | |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 21Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| **Volatile Organic Compounds** | | | |
| Compound: Acetone | | | Recommended BCF Value: 0.05 |
| No empirical data were available for acetone or for a structurally-similar surrogate compound.The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder (1978), where log $K_{ow}$ = -0.222 (Karickoff and Long 1995). | | | |
| Compound: Acrylonitrile | | | Recommended BCF Value: 0.11 |
| No empirical data were available for acrylonitrile or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.250 (Karickoff and Long 1995). | | | |
| Compound: Chloroform | | | Recommended BCF Value: 2.82 |
| No empirical data were available for chloroform or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.949 (U.S. EPA 1994b). | | | |
| Compound: Crotonaldehyde | | | Recommended BCF Value: 0.20 |
| No empirical data were available for crotonaldehyde or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.55 (Based on equations developed by Hansch and Leo 1979, calculated in NRC (1981)). | | | |
| Compound: 1,4-Dioxane | | | Recommended BCF Value: 0.04 |
| No empirical data were available for 1,4-dioxane or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.268 (U.S. EPA 1995a). | | | |
| Compound: Formaldehyde | | | Recommended BCF Value: 0.14 |
| No empirical data were available for formaldehyde or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.342 (U.S. EPA 1995a). | | | |
| Compound: Vinyl chloride | | | Recommended BCF Value: 0.62 |
| No empirical data were available for vinyl chloride or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.146 (U.S. EPA 1994b). | | | |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 22Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| **Other Chlorinated Organics** | | | |
| Compound: Carbon Tetrachloride | | | Recommended BCF Value: 12.0 |
| No empirical data were available for carbon tetrachloride or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 2.717 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorobenzene | | | Recommended BCF Value: 2,296 |
| No empirical data were available for hexachlorobenzene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 5.503 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorobutadiene | | | Recommended BCF Value: 535 |
| No empirical data were available for hexachlorobutadiene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where log $K_{ow}$ = 4.731 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF Value: 745 |
| No empirical data were available for hexachlorocyclopentadiene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder (1978), where log $K_{ow}$ = 4.907 (U.S. EPA 1994b). | | | |
| Compound: Pentachlorobenzene | | | Recommended BCF Value: 1,050 |
| No empirical data were available for pentachlorobenzene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder (1978), where log $K_{ow}$ = 5.088 (U.S. EPA 1994b). | | | |
| Compound: Pentachlorophenol | | | Recommended BCF Value: 1,034 |
| No empirical data were available for pentachlorophenol or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder (1978), where log $K_{ow}$ = 5.080 (U.S. EPA 1994b). | | | |
| **Pesticides** | | | |
| Compound: 4,4'-DDE | | | Recommended BCF Value: 1.26 |
| Empirical data for 4,4'-DDE were not available. The BCF was calculated using the geometric mean of 13 laboratory values for 4,4'-DDT. The first six values reported in Gish (1970), Davis (1971), and Beyer and Gish (1980) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.08 0.39<br>0.29 0.41 | Davis (1971) | Chronic exposure | *Lumbricus terrestris* |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 23Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| 0.83 | Beyer and Gish (1980) | Chronic exposure | *Aporrectodea trapezoides*<br>*Aparrectodea turgida*<br>*Allolobophora chlorotica*<br>*Lumbricus terrestris* |
| 0.85 1.20<br>2.40 4.60<br>2.50 1.60 | Wheatley and Hardman (1968) | Chronic exposure | Not specified |
| 10.00<br>14.46 | Yadav, Mittad, Agarwal, and Pillai (1981) | Chronic exposure | *Pheretima posthuma* |
| Compound: Heptachlor | | | Recommended BCF Value: 1.40 |
| Empirical data for heptachlor were not available. The BCF was calculated using 1 laboratory value for heptachlor epoxide. The value reported in Beyer and Gish (1980) was converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 1.40 | Beyer and Gish (1980) | Chronic exposure | *Aporrectodea trapezoides*<br>*Aparrectodea turgida*<br>*Allolobophora chlorotica*<br>*Lumbricus terrestris* |
| Compound: Hexachlorophene | | | Recommended BCF Value: 106,970 |
| No empirical data were available for hexachlorophene or for a structurally-similar surrogate compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder (1978), where log $K_{ow}$ = 7.540 (Karickoff and Long 1995). | | | |
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF Value: 0.22 |
| Empirical data for aluminum were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Antimony | | | Recommended BCF Value: 0.22 |
| Empirical data for antimony were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Arsenic | | | Recommended BCF Value: 0.11 |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 24Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the geometric mean of 5 laboratory values for arsenic as listed below. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.14 0.10<br>0.10 0.17<br>0.06 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| Compound: Barium | | | Recommended BCF Value: 0.22 |
| Empirical data for barium were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Beryllium | | | Recommended BCF Value: 0.22 |
| Empirical data for beryllium were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Cadmium | | | Recommended BCF Value: 0.96 |
| The BCF was calculated using the geometric mean of 22 laboratory values for cadmium. The values reported in Rhett, Simmers, and Lee (1988) and Simmers, Rhett, and Lee (1983) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.33 0.72<br>0.25 0.19<br>3.17 0.55<br>0.70 0.35 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 0.13 0.50<br>0.29 8.77<br>1.25 7.86<br>0.17 6.67<br>0.11 3.95<br>8.01 1.50<br>4.39 2.10 | Simmers, Rhett, and Lee (1983) | Chronic exposure | *Allolobophora longa*<br>*A. caliginosa*<br>*A. rosea*<br>*A. chlorotica*<br>*Lumbricus terrestris*<br>*A. lumbricus*<br>*Octolasium* sp. |
| Compound: Chromium (total) | | | Recommended BCF Value: 0.01 |
| The BCF was calculated using the geometric mean of 3 laboratory values for chromium. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 25Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| 0.004<br>0.004<br>0.05 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| Compound: Copper | | | Recommended BCF Value: 0.04 |
| The BCF was calculated using the geometric mean of 9 laboratory values for copper. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.02 0.03<br>0.01 0.03<br>0.20 0.03<br>0.04 0.04 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 0.24 | Ma (1987) | Chronic exposure | *Lumbricus rubellus* |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 26Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Cyanide (total) | | | Recommended BCF Value: 1.12 |
| Empirical data for cyanide were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, methyl mercury, nickel, and zinc). | | | |
| Compound: Lead | | | Recommended BCF Value: 0.03 |
| The BCF was calculated using the geometric mean of 6 laboratory values for lead. The values reported in Rhett, Simmers, and Lee (1988), Ma (1987), and Van Hook (1974) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.02<br>0.006<br>0.07 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 0.19 | Ma (1987) | Chronic exposure | Not specified |
| 0.12 | Ma (1982) | | Not specified |
| 0.03 | Van Hook (1974) | Chronic exposure | *Alabophera* sp.<br>*Lumbricus* sp.<br>*Octolasium* sp. |
| Compound: Mercuric chloride | | | Recommended BCF Value: 0.04 |
| The BCF was calculated using the geometric mean of 5 laboratory values for mercuric chloride. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.04 0.04<br>0.06 0.04<br>0.02 | Rhett, Simmers, and Lee (1988) | 28-day exposure; tissue concentrations of <0.05 were reported for the first three ratios, however, a concentration of 0.05 was used in order to calculate a conservative BCF value. | *Eisenia foetida* |
| Compound: Methyl mercury | | | Recommended BCF Value: 8.50 |
| The BCF was calculated using the geometric mean of 3 laboratory values as presented below. The values reported in Beyer, Cromartie, and Moment (1985) were earthworm wet weight over soil wet weight with 60 percent soil moisture. The soil weight was converted to dry weight to result in the values presented below: | | | |
| 8.25<br>8.31<br>8.95 | Beyer, Cromartie, and Moment (1985) | 6 to 12-week exposure | *Eisenia foetida* |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 27Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Nickel | | | Recommended BCF Value: 0.02 |
| The BCF was calculated using the geometric mean of 3 laboratory values for nickel. The values reported in Rhett, Simmers, and Lee (1988) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | | | |
| 0.03<br>0.01<br>0.04 | Rhett, Simmers, and Lee 1988 | 28-day exposure | *Eisenia foetida* |
| Compound: Selenium | | | Recommended BCF Value: 0.22 |
| Empirical data for selenium were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Silver | | | Recommended BCF Value: 0.22 |
| Empirical data for silver were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |
| Compound: Thallium | | | Recommended BCF Value: 0.22 |
| Empirical data for thallium were not available. The recommended BCF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc). | | | |

## TABLE C-1

## SOIL-TO-SOIL INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC/kg wet tissue) / (mg COPC/kg dry soil)



| 28Reported Values[a] | References | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Zinc | | | Recommended BCF Value: 0.56 |
| The BCF was calculated using the geometric mean of 5 laboratory values for zinc. The values reported in Rhett, Simmers, and Lee (1988), Ma (1987), and Van Hook (1974) were converted to wet weight over dry weight using a conversion factor of 5.99 [a]. | | | |
| 0.11<br>0.06<br>0.58 | Rhett, Simmers, and Lee (1988) | 28-day exposure | *Eisenia foetida* |
| 10.79 | Ma (1987) | Chronic exposure | Not specified |
| 1.28 | Van Hook (1974) | Chronic exposure | *Alabophera* sp.<br>*Lumbricus* sp.<br>*Octolasium* sp. |

Notes:

(a) The reported values are presented as the amount of COPC in invertebrate tissue divided by the amount of COPC in the soil. If the values reported in the studies were presented as dry tissue weight over dry soil weight, they were converted to wet weight over dry weight by dividing the concentration in dry earthworm tissue weight by 5.99. This conversion factor assumes an earthworm's total weight is 83.3 percent moisture (Pietz et al. 1984).

The conversion factor was calculated as follows:

$$Conversion\ factor = \frac{1.0\ gram\ (g)\ earthworm\ total\ weight}{1.0\ g\ earthworm\ total\ weight\ -\ 0.833\ g\ earthworm\ wet\ weight}$$

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) | | | Recommended BCF Value: 0.0056 |
| The BCF for these constituents were calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.64 (U.S. EPA 1994a). | | | |
| Compound: 1,2,3,7,8-Tetrachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD) | | | Recommended BCF Value: 0.0052 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x 0.92 =0.0052 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-HxCDD) | | | Recommended BCF Value: 0.0017 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.31 = 0.0017 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-HxCDD) | | | Recommended BCF Value: 0.00067 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.12 = 0.00067 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-HxCDD) | | | Recommended BCF Value: 0.00078 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x 0.14 = 0.00078 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD) | | | Recommended BCF Value: 0.00029 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.051 = 0.00029 | | | |
| Compound: Octachlorodibenzo-p-dioxin (OCDD) | | | Recommended BCF Value: 0.000067 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x 0.012 = 0.000067 | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzo-p-furan (2,3,7,8-TCDF) | | | Recommended BCF Value: 0.0045 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.80 = 0.0045 | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzo-p-furan (1,2,3,7,8-PeCDF) | | | Recommended BCF Value: 0.0011 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.22 = 0.0011 | | | |
| Compound: 2,3,4,7,8-Pentachlorodibenzo-p-furan (2,3,4,7,8-PeCDF) | | | Recommended BCF Value: 0.0090 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x1.6 = 0.0090 | | | |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
**(mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)**



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo-p-furan (1,2,3,4,7,8-HxCDF) | | | Recommended BCF Value: 0.00043 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x 0.076 = 0.00043 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo-p-furan (1,2,3,6,7,8-HxCDF) | | | Recommended BCF Value: 0.0011 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.19 = 0.0011 | | | |
| Compound: 2,3,4,6,7,8-Hexachlorodibenzo-p-furan (2,3,4,6,7,8-HxCDF) | | | Recommended BCF Value: 0.0038 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.67 = 0.0038 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo-p-furan (1,2,3,7,8,9-HxCDF) | | | Recommended BCF Value: 0.0035 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.63 = 0.0035 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo-p-furan (1,2,3,4,6,7,8-HpCDF) | | | Recommended BCF Value: 0.000062 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =0.0056 x0.011 = 0.00062 | | | |
| Compound: 1,2,3,4,7,8,9-Heptachlorodibenzo-p-furan (1,2,3,4,7,8,9-HpCDF) | | | Recommended BCF Value: 0.0022 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.39 = 0.0022 | | | |
| Compound: Octachlorodibenzo-p-furan (OCDF) | | | Recommended BCF Value: 0.000090 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 0.0056 x0.016 = 0.000090 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAH)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF Value: 0.0 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.129 (U.S. EPA 1994b). | | | |
| Compound: Benzo(a)anthracene | | | Recommended BCF Value: 0.0202 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.679 (U.S. EPA 1994b). | | | |
| Compound Benzo(b)fluoranthene | | | Recommended BCF Value: 0.0101 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.202 (U.S. EPA 1994b). | | | |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF Value: 0.0101 |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.2 (Karickhoff and Long 1995). | | | |
| Compound: Chrysene | | | Recommended BCF Value: 0.0187 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.739 (U.S. EPA 1994b). | | | |
| Compound: Dibenzo(a,h)anthracene | | | Recommended BCF Value: 0.0064 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.547 (U.S. EPA 1994b). | | | |
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF Value: 0.0039 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 6.915 (U.S. EPA 1994b). | | | |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF Value: 0.01 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988); using the log $K_{ow}$ for Aroclor 1254, where log $K_{ow}$= 6.207 (U.S. EPA 1994b). | | | |
| Compound: Aroclor 1254 | | | Recommended BCF Value: 0.01 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988); using the log $K_{ow}$ for Aroclor 1254, where log $K_{ow}$= 6.207 (U.S. EPA 1994b). | | | |
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF Value: 5.32 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 1.491 (U.S. EPA 1994b). | | | |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF Value: 2.72 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ =1.996 (U.S. EPA 1994b). | | | |
| Compound 2,6-Dinitrotoluene | | | Recommended BCF Value: 3.15 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 1.886 (U.S. EPA 1994b). | | | |
| Compound: Nitrobenzene | | | Recommended BCF Value: 3.38 |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 1.833 (U.S. EPA 1994b). | | | |
| Compound: Pentachloronitrobenzene | | | Recommended BCF Value: 0.08 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 4.640 (U.S. EPA 1994b). | | | |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF Value: 0.038 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.205 (U.S. EPA 1994b). | | | |
| Compound: Di(n)octyl phthalate | | | Recommended BCF Value: 0.000157 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 9.33 (U.S. EPA 1994b). | | | |
| **Volatile organic compounds** | | | |
| Compound: Acetone | | | Recommended BCF Value: 52 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = -0.222 (U.S. EPA 1994c). | | | |
| Compound: Acrylonitrile | | | Recommended BCF Value: 27.77 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 0.250 (Karickhoff and Long 1995). | | | |
| Compound: Chloroform | | | Recommended BCF Value: 2.9 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 1.949 (U.S. EPA 1994b). | | | |
| Compound: Crotonaldehyde | | | Recommended BCF Value: 18.63 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 0.55 (Hansch and Leo 1979). | | | |
| Compound: 1,4-Dioxane | | | Recommended BCF Value: 55.32 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = -0.268 (U.S. EPA 1995c). | | | |
| Compound: Formaldehyde | | | Recommended BCF Value: 24.57 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 0.342 (U.S. EPA (1995c). | | | |
| Compound: Vinyl chloride | | | Recommended BCF Value: 8.43 |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988). where log $K_{ow}$ = 1.146 (U.S. EPA 1994b). | | | |
| **Other Chlorinated Organics** | | | |
| Compound: Carbon tetrachloride | | | Recommended BCF Value: 1.04 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 2.717 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorobenzene | | | Recommended BCF Value: 0.0255 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.503 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorobutadiene | | | Recommended BCF Value: 0.0714 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 4.731 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF Value: 0.0565 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 4.907 (U.S. EPA 1994b). | | | |
| Compound: Pentachlorobenzene | | | Recommended BCF Value: 0.044 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.088 (U.S. EPA 1994b). | | | |
| Compound: Pentachlorophenol | | | Recommended BCF Value: 0.0449 |
| The BCF was calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988), where log $K_{ow}$ = 5.08 (U.S. EPA 1994b). | | | |
| **Pesticides** | | | |
| Compound: 4,4-DDE | | | Recommended BCF Value: 0.00937 |
| The BCF for these constituents were calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988)., where log $K_{ow}$ = 6.256 (U.S. EPA 1994b). | | | |
| Compound: Heptachlor | | | Recommended BCF Value: 0.0489 |
| The BCF for these constituents were calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988)., where log $K_{ow}$ = 5.015 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorophene | | | Recommended BCF Value: 0.0017 |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF for these constituents were calculated using the following regression equation: log BCF = 1.588 - 0.578 x log $K_{ow}$ (Travis and Arms 1988)., where log $K_{ow}$ = 7.54 (Karickhoff and Long 1995). | | | |
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF Value: 0.004 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Antimony | | | Recommended BCF Value: 0.2 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Arsenic | | | Recommended BCF Value: 0.036 |
| The BCF for this constituent was based on empirical data reported in U.S. EPA (1992c). Experimental parameters were not reported. | | | |
| Compound Barium | | | Recommended BCF Value: 0.15 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Beryllium | | | Recommended BCF Value: 0.01 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Cadmium | | | Recommended BCF Value: 0.364 |
| The BCF for this constituent was based on empirical data reported in U.S. EPA (1992c). Experimental parameters were not reported. | | | |
| Compound: Chromium (total) | | | Recommended BCF Value: 0.0075 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Copper | | | Recommended BCF Value: 0.4 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Cyanide (total) | | | Recommended BCF Value: No data |
| No empirical or $K_{ow}$ data were available for this constituent. | | | |
| Compound: Lead | | | Recommended BCF Value: 0.045 |

## TABLE C-2

## SOIL-TO-PLANT AND SEDIMENT-TO- PLANT BIOCONCENTRATION FACTORS
## (mg COPC/kg dry tissue) / (mg COPC/kg dry soil or sediment)



| Reported Values | References | Experimental Parameters | Species |
|---|---|---|---|
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Mercuric chloride | | | Recommended BCF Value: 0.0375 |
| The BCF was calculated using the geometric mean of 3 values for mercuric chloride ($HgCl_2$). | | | |
| 0.022<br>0.032<br>0.075 | Cappon (1981) | The values were derived from studies during one growing season using 20 food crop vegetables. | Not specified. |
| Compound: Methyl mercury | | | Recommended BCF Value: 0.137 |
| The BCF was calculated using the geometric mean of 3 values for methyl mercury. | | | |
| 0.062<br>0.149<br>0.277 | Cappon (1981) | The values were derived from studies during one growing season using 20 food crop vegetables. | Not specified. |
| Compound: Nickel | | | Recommended BCF Value: 0.032 |
| The BCF for this constituent was based on empirical data reported in U.S. EPA (1992c). Experimental parameters were not reported. | | | |
| Compound: Selenium | | | Recommended BCF Value: 0.016 |
| The BCF for this constituent was based on empirical data reported in U.S. EPA (1992c). Experimental parameters were not reported. | | | |
| Compound: Silver | | | Recommended BCF Value: 0.4 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Thallium | | | Recommended BCF Value: 0.004 |
| The BCF for this constituent was based on empirical data reported in Baes, Sharp, Sjoreen and Shor (1984). Experimental parameters were not reported. | | | |
| Compound: Zinc | | | Recommended BCF Value: 0.0000000000012 |
| The BCF for this constituent was based on empirical data reported in U.S. EPA (1992c). Experimental parameters were not reported. | | | |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) | | | Recommended BCF Value: 1,560 |
| The BCF value was calculated using the geometric mean of 2 values from data reported for 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD). | | | |
| 1,762<br>1,381 | Yockim, Isensee, and Jones (1978) | 32-day exposure duration | Daphnid; *Heliosoma* sp. |
| Compound: 1,2,3,7,8-Pentachlorodibenzo(p)dioxin (1,2,3,7,8-PeCDD) | | | Recommended BCF Value: 1,435 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.92 =1,435 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,4,7,8-HxCDD) | | | Recommended BCF Value: 483.6 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.31 =483.6 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,6,7,8-HxCDD) | | | Recommended BCF Value: 187.2 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.12 =187.2 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo(p)dioxin (1,2,3,7,8,9-HxCDD) | | | Recommended BCF Value: 218.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.14 = 218.4 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo(p)dioxin (1,2,3,4,6,7,8-HpCDD) | | | Recommended BCF Value: 79.6 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.051 = 79.6 | | | |
| Compound: Octachlorodibenzo(p)dioxin (OCDD) | | | Recommended BCF Value: 18.7 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.012 = 18.7 | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF) | | | Recommended BCF Value: 1248 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.80 = 124 | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF) | | | Recommended BCF Value: 343.2 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.22 = 343.2 | | | |
| Compound: 2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF) | | | Recommended BCF Value: 2,496 |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 1.6 = 2,496 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF) | | | Recommended BCF Value: 118.6 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.076 = 118.6 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-HxCDF) | | | Recommended BCF Value: 296.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.19 = 296.4 | | | |
| Compound: 2,3,4,6,7,8-Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF) | | | Recommended BCF Value: 1,045 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.67 = 1,045 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-HxCDF) | | | Recommended BCF Value: 982.8 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.63 = 982.8 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF) | | | Recommended BCF Value: 17.2 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.011 = 17.2 | | | |
| Compound: 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF) | | | Recommended BCF Value: 608.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.39 = 608.4 | | | |
| Compound: Octachlorodibenzofuran (OCDF) | | | Recommended BCF Value: 25.0 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =1,560 x 0.016 = 25.0 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF Value: 4,697 |
| The BCF value was calculated using the geometric mean of 6 laboratory values as follows: | | | |
| 55,000 | Eadie, Landrum, and Faust (1982) | Reported as the mean of the measured PAH concentrations in the test species and the sediment | *Pontoporcia hoyi* |
| 12,761 | Newsted and Giesy (1987) | 24-hour exposure duration | *Daphnia magna* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 861 | Roesijadi, Anderson, and Blaylock (1978) | 7-day exposure duration | *Macoma inquinata* |
| 3,000 | Lee, Gardner, Anderson, Blaytock, and Barwell-Clarke (1978) | 8-day exposure duration. The reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)] conversion factor of 1 x $10^3$ was applied to the value. | *Crassostrea virginica* |
| 2,745<br>2,158 | Leversee, Landrum, Giesy, and Fannin (1983) | 6-hour exposure duration; 0.2 ppm concentrated humic acid added to test medium | *Daphnia magna* |
| Compound: Benzo(a)anthracene | | | Recommended BCF Value: 12,299 |
| The BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 18,000 | Lee, Gardner, Anderson, Blaytock, and Barwell-Clarke (1978) | 8-day exposure duration; The reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)] conversion factor of 1 x $10^3$ was applied to the value. | *Crassostrea virginica* |
| 10,225 | Newsted and Giesy (1987) | 24-hour exposure duration | *Daphnia magna* |
| 10,109 | Southworth, Beauchamp, and Schmieder (1978) | 24-hour exposure duration | *Daphnia pulex* |
| Compound: Benzo(b)fluoranthene | | | Recommended BCF Value: 4,697 |
| Laboratory data were not available for this constituent. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF Value: 13,225 |
| The BCF value was based on one laboratory value as follows: | | | |
| 13,225 | Newsted and Giesy (1987) | 24-hour exposure duration | *Daphnia magna* |
| Compound: Chrysene | | | Recommended BCF Value: 980 |
| The BCF value was calculated using the geometric mean of 7 laboratory values as follows: | | | |
| 5,500 | Eastmond, Booth, and Lee (1984) | Not reported | *Daphnia magna* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 248 199<br>1,809 418 | Millea, Corliss, Farragut, and Thompson (1982) | 28-day exposure duration; reported values were based on accumulation in the cephalothorax and abdomen at exposures of 1 or 5 µg/L in a cloed seawater system. | *Penaeus duorarum* |
| 6,088 | Newsted and Giesy (1987) | 24-hour exposure duration | *Daphnia magna* |
| 694 | Roesijadi, Anderson, and Blaylock (1978) | 7-day exposure duration | *Macoma inquinata* |
| Compound: Dibenzo(a,h)anthracene | | | Recommended BCF Value: 710 |
| The BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 652<br>773 | Leversee, Landrum, Giesy, and Fannin (1983) | 6-hour exposure duration | *Daphnia magna* |
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF Value: 4,697 |
| Laboratory data were not available for this constituent. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF Value: 13,000 |
| The BCF value for Aroclor 1016 was calulated using one laboratory value as follows: | | | |
| 13,000 | Parrish et al. (1974) as cited in EPA (1980b) | 84 day exposure<br>Edible portion | *Crassostrea virginica* |
| Compound: Aroclor 1254 | | | Recommended BCF Value: 5,538 |
| The BCF value for Aroclor 1254 was calulated using the geometric mean 13 laboratory values as follows: | | | |
| 41,857<br>6,900<br>5,679 | Rice and White (1987) | Field study | *Sphaerium striatum* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 750 740<br>3,800 1,500<br>6,200 3,500<br>2,600 2,700 | Mayer, Mehrle, and Sanders (1977) | 4 to 21-day exposure | *Orconectes nais; Daphnia magna; Gammarus pseudolimnaeus; Palaemontes kadiakensis; Corydalus cornutus; Culex tarsalis; Chaoborus punctipennis* |
| 120,000 | Veith, Kuehl, Puglisi, Glass, and Eaton (177) | Field samples | Zooplankton |
| 340,000 in lipid<br>51,000 dry tissue | Scura and Theilacker (1977) | 45 days exposure | *Brachionus plicatilis* |
| >27,000 | Nimmo et al. (1977) as cited in EPA (1980b) | Field data<br>Whole body | Invertebrates |
| 740 | Mayer et al. (1977) as cited in EPA (1980b) | 21 days exposure | *Pteronarcys dorsata* |
| 1,500 | Mayer et al. (1977) as cited in EPA (1980b) | 7 days exposre | *Corydalus cornutus* |
| 750 | Mayer et al. (1977) as cited in EPA (1980b) | 21 days exposure | *Orconectes nais* |
| 373 | Mayer et al. (1977) as cited in EPA (1980b) | 5 days exposure | *Nereis diversicolor* |
| 140 | Duke et al. (1970) as cited in EPA (1980b) | 2 day exposure | *Penaeus duorarum* |
| 8,100 | Duke et al. (1970) as cited in EPA (1980b) | 2 days exposure | *Crassostrea virginica* |
| 236 | Courtney and Langston (1978) as cited in EPA (1980b) | 5 days exposure | *Arenicola marina* |
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF Value: 13 |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Laboratory data were not available for this constituent. BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF Value: 13 |
| The recommended BCF value is based on one study as follows: | | | |
| 13 | Liu, Bailey, and Pearson (1983) | 4-day exposure duration | *Daphnia magna* |
| Compound: 2,6-Dinitrotoluene | | | Recommended BCF Value: 13 |
| Laboratory data were not available for this constituent. BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| Compound: Nitrobenzene | | | Recommended BCF Value: 13 |
| Laboratory data were not available for this constituent. BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| Compound: Pentachloronitrobenzene | | | Recommended BCF Value: 13 |
| Laboratory data were not available for this constituent. BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF Value: 318 |
| The BCF value was calculated using the geometric mean of 12 laboratory values as follows: | | | |
| 2,497 | Brown and Thompson (1982) | 14 to 28-day exposure duration | *Mytilus edulis* |
| 257 | Perez, Davey, Lackie, Morrison, Murphy, Soper, and Winslow (1983) | 30-day exposure duration | *Pitar morrhauna* |
| 48<br>2237 | Sanders, Mayer, and Walsh (1973) | 14-day exposure duration; The reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)], and a conversion factor of 1 x $10^3$ was applied to the value. The reported value was also converted from dry weight to wet weight using a conversion factor of 5.99[a]. | *Gammarus pseudolimnacus* |
| 1,214 17,473<br>2,271 24,456 | Sodergren (1982) | 27-day exposure duration | *Chironomus* sp.; *Sialis* sp.; *Phanorbis corneus*; *Gammarus pulex* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 11<br>10<br>7<br>17 | Wofford, Wilsey, Neff, Giam, and Neff (1981) | 24-hour exposure duration | *Crassostrea virginica*; *Penaeus aztecus* |
| Compound: Di(n)octyl phahalate | | | Recommended BCF Value: 5,946 |
| The BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 13,600<br>2,600 | Sanborn, Metcalf, Yu, and Lu (1975) | Not reported | *Physia* sp.; *Daphnia* sp. |
| **Volatile Organic Compounds** | | | |
| Compound: Acetone | | | Recommended BCF Value: 0.05 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.222 (Karickoff and Long 1995). | | | |
| Compound: Acrylonitrile | | | Recommended BCF Value: 0.11 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where Log $K_{ow}$ = 0.250 (Karickoff and Long 1995). | | | |
| Compound: Chloroform | | | Recommended BCF Value: 2.82 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.949 (U.S. EPA 1994b). | | | |
| Compound: Crotonaldehyde | | | Recommended BCF Value: 0.20 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where, log $K_{ow}$ = 0.55 (Based on equation developed by Hansch and Leo (1979), as calculated in NRC (1981)). | | | |
| Compound: 1,4-Dioxane | | | Recommended BCF Value: 0.043 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where, log $K_{ow}$ = -0.268 (U.S. EPA 1995a). | | | |
| Compound: Formaldehyde | | | Recommended BCF Value: 0.14 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where, log $K_{ow}$ = 0.342 (U.S. EPA 1995a). | | | |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Vinyl chloride | | | Recommended BCF Value: 0.62 |
| Laboratory data were not available for this constituent.The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where, log $K_{ow}$ = 1.146 (U.S. EPA 1994b). | | | |
| **Other Chlorinated Organics** | | | |
| Compound: Carbon tetrachloride | | | Recommended BCF Value: 12 |
| Laboratory data were not available for this constituent. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978) where, log $K_{ow}$ = 2.717 (U.S. EPA 1994b). | | | |
| Compound: Hexachlorobenzene | | | Recommended BCF Value: 2,595 |
| The BCF value was calculated using the geometric mean of 16 laboratory values as follows: | | | |
| 215,331<br>8,051<br>11,064 | Baturo and Lagadic (1996) | 48 to 120-hour exposure duration | *Lymnaea palustris* |
| 1,360 770<br>1,510 940<br>1,630 1,030 | Isensee, Holden, Woolson, and Jones (1976) | 31-day exposure duration | *Heliosoma* sp.; *Daphnia magna* |
| 287<br>1,247 | Metcalf, Kapoor, Lu, Schuth, and Sherman (1973) | 1 to 33-day exposure duration | *Daphnia magna; Physa* sp. |
| 17,140<br>21,820<br>5,000 | Nebeker, Griffis, Wise, Hopkins, and Barbitta (1989) | 28-day exposure duration | *Oligochaete* |
| 24,000 | Oliver (1987) | 79-day exposure duration | *Oligochaete* |
| 5.5 | Schauerte, Lay, Klein, and Korte (1982) | 4 to 6-week exposure duration | *Dytiscus marginalis* |
| Compound: Hexachlorobutadiene | | | Recommended BCF Value: 10.5 |
| The BCF value was based on four laboratory values from one study as follows: | | | |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 6.27<br>45.4<br>11.1<br>3.86 | Laseter, Bartell, Laska, Holmquist, Condie, Brown, and Evans (1976) | 10-day exposure duration | *Procambarus clarki* |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF Value: 1,232 |
| The BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 929<br>1,634 | Lu, Metcalf, Hirwe, and Williams (1975) | Not reported | *Physa* sp.<br>*Culex* sp. |
| Compound: Pentachlorobenzene | | | Recommended BCF Value: 2,595 |
| Laboratory data were not available for this constituent. The BCF for hexachlorobenzene was used as a surrogate. | | | |
| Compound: Pentachlorophenol | | | Recommended BCF Value: 52 |
| The BCF value was calculated using the geometric mean of 13 laboratory values as follows: | | | |
| 145<br>342 | Makela and Oikari (1990) | 1-day exposure duration | *Anodonta anatina* |
| 165 | Lu and Metcalf (1975) | 1-day exposure duration | *Daphnia magna* |
| 81<br>461 | Makela, Petanen, Kukkonen, and Oikari (1991) | Multiple exposure durations | *Anodonta anatina* |
| 80 61<br>121 85 | Makela and Oikari (1995) | 2 to 36-week exposure duration | *Anodonta anatina*; *Pseudanodonta complanta* |
| 42 0.26<br>72 1.7 | Schimmel, Patrick, and Faas (1978) | 28-day exposure duration | *Crassostrea virginica*; *Penaeus aztecus*; *Palaemonetes pugio* |
| **Pesticides** | | | |
| Compound: 4,4'-DDE | | | Recommended BCF Value: 11,930 |
| The recommended BCF value was calculated using the geometric mean of 14 field values[b] (Reich, Perkins, and Cutter 1986). | | | |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)

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| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 19,400 4,421<br>207,070 8,782<br>67,641 2,374<br>5,099 2,197<br>8,344 46,953<br>15,369 35,373<br>4,983 3,972 | Reich, Perkins, and Cutter (1986) | Field samples. | *Tubificidae; Chironomidae; Corixidae* |
| 36,342<br>39,390 | Metcalf, Sanborn, Lu, and Nye (1975) | 33-day exposure duration | *Physa* sp.; *Culex pipiens quinquefasciatus* |
| 28,600 1310<br>63,500 51,600<br>36,400 | Hamelink, Waybrant, and Yant (1977) | Not reported | Zooplankton |
| 19,528<br>5,024 | Metcalf, Sangha, and Kapoor (1971) | 33-day exposure duration; The value reported in Hamelink and Waybrant (1976) was converted to wet weight over dry weight using a conversion factor was 5.99[a]. | *Physa* sp.; *Culex pipiens quinquefasciatus* |
| 19,529 | Metcalf, Kapoor, Lu, Schuth, and Sherman (1973) | 33-day exposure duration | *Physa* sp. |
| Compound: Heptachlor | | | Recommended BCF Value: 3,807 |
| The BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 37,153<br>31,403 | Lu, Metcalf, Plummer, and Mandel (1975) | Not reported | *Physa* sp.<br>*Culex* sp. |
| 300<br>600 | Schimmel, Patrick, and Forester (1976) | 96 hour exposure duration | *Penaeus duorarum* |
| Compound: Hexachloropehene | | | Recommended BCF Value: 970 |
| The BCF value was based on one study as follows: | | | |
| 970 | Sanborn (1974) | Not reported | *Physa* sp. |
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF Value: 4,066 |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Laboratory data were not available for this constituent. The recommended BCF is the arithmetic mean of the recommended values for 14 inorganics with laboratory data available (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc). | | | |
| Compound: Antimony | | | Recommended BCF Value: 7 |
| The BCF value was calculated using the geometric means of 2 laboratory values as follows: | | | |
| 10 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater and marine invertebrates |
| Compound: Arsenic | | | Recommended BCF Value: 73 |
| The BCF value was calculated using the geometric mean of 5 laboratory values as follows: | | | |
| 33 50<br>45 219<br>131 | Spehar, Fiandt, Anderson, and DeFoe (1980) | 21 to 28-day exposure duration | *Pteronarcys dorsata*; *Daphnia magna* |
| Compound: Barium | | | Recommended BCF Value: 200 |
| The BCF was based on one study as follows: | | | |
| 200 | Thompson, Burton, Quinn and Ng (1972) | Not reported | Freshwater invertebrate |
| Compound: Beryllium | | | Recommended BCF Value: 45 |
| The BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 10<br>200 | Thompson, Burton, Quinn and Ng (1972) | Not reported | Freshwater invertebrate |
| Compound: Cadmium | | | Recommended BCF Value: 3,461 |
| The BCF value was calculated using the geometric mean of 8 field values as follows: | | | |
| 238 549<br>894 3,577<br>11,383 15,936<br>9,897 27,427 | Saiki, Castleberry, May, Martin, and Bullard (1995) | Field samples. | *Chironomidea; Ephermeroptera* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 1,490<br>2,460<br>720 | Eisler, Zaroogian, and Hennekey (1972) | 3-week exposure duration | *Crassostrea virginica*; *Aquipecten irradians*; *Homarus americanus* |
| 165 | George and Coombs (1977) | 28-day exposure duration | *Mytilus edulis* |
| 1,359 137<br>2,939 217<br>615 1,850<br>573 1,530<br>1,082 781<br>775 553 | Giesy, Kanio, Boling, Knight, Mashburn, and Clarkin (1977) | 52-week exposure duration; the reported value was calculated by dividing the dry tissue concentration by the medium concentration [(µg/g)/(µg/L)] conversion factor of 1 x $10^3$ was applied to the value. A conversion factor or 5.99[(a)] was used to convert dry weight to wet weight. | *Ceratopogonidae; Chironomidae;* Beetle*; Anisotptera; Zygoptera; Ephemeroptera* |
| 1,840 | Gillespie, Reisine, and Massaro (1977) | 8-day exposure duration; the reported value was calculated by dividing the dry tissue concentration by the medium concentration [(ppm)/(ppb)] and a conversion factor of 1 x $10^3$ was applied to the value. | *Orconectes propinquos propinquos* |
| 3,770<br>1,752 | Graney, Cherry, and Cairns (1983) | 28-day exposure duration | *Corbicula fluminea* |
| 1.86<br>6.88<br>7.18 | Jennings and Rainbow (1979) | 40-day exposure duration; the reported value was calculated by dividing the dry tissue concentration by the medium concentration [(mg/g)/(ppm)] conversion factor of 1 x $10^3$ was applied to the value. A conversion factor or 5.99[(a)] was used to convert dry weight to wet weight. | *Carcinus maenas* |
| 660<br>3400 | Klockner (1979) | 64-day exposure duration | *Ophryothochadiadema* sp. |
| 48 33<br>57 34<br>55 23 | Nimmo, Lightner, and Bahner (1977) | 28 to 30-day exposure duration | *Penaeus duorarum* |
| 1,023 17.7<br>1,477 17.5<br>2,412 30<br>3,406 28.7<br>37.2 | Pesch and Stewart (1980) | 42-day exposure duration; the values reported in Pesch and Stewart (1980) were converted to wet weight using a conversion factor of 5.99[(a)]. | *Argopecten irradians*; *Palaemonetes pugio* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 57 301<br>341 167 | Phillips (1976) | 35-day exposure duration; the reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)] conversion factor of 1 x $10^3$ was applied to the value. | *Mytilus edulis* |
| 160 | Pringle, Hissong, Katz, and Mulawka (1968) | 70-day exposure duration | *Mya arenaria* |
| 3,500 | Sundelin (1983) | 66-week exposure duration | *Pontoporeia affinis* |
| 123 89<br>93 67<br>48 115 | Theede, Scholz, and Fischer (1979) | 7 and 10-day exposure duration; the reported value was calculated by dividing the dry tissue concentration by the medium concentration [(µg/g)/(µg/L)] conversion factor of 1 x $10^3$ was applied to the value. A conversion factor or 5.99[a] was used to convert dry weight to wet weight. | *Laomedea loveni* |
| 2,150<br>13,600 | Zaroogian and Cheer (1976) | 40-week exposure | *Crassostrea virginica* |
| Compound: Chromium (total) | | | Recommended BCF Value: 3,000 |
| The BCF value was based on 1 field value as follows: | | | |
| 3,000 | Namminga and Wilhm (1977) | Field samples. | *Chironomidae* |
| 1,900 | NAS (1974) | Not reported | Zooplankton |
| 2,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater invertebrates |
| Compound: Copper | | | Recommended BCF Value: 3,718 |
| The BCF value was calculated using the geometric mean of 9 field values as follows: | | | |
| 546 | Namminga and Wilhm (1977) | Field samples. | *Chironomidae* |
| 2,896 3,066<br>5,111 4,940<br>11,130 4,174<br>8,347 2,862 | Saiki, Castleberry, May, Martin, and Bullard (1995) | Field samples. | *Chironomidae*; *Ephemeroptera* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 373 | Eisler (1977) | 14-day exposure duration | *Mya arenara* |
| 17,720<br>22,571 | Graney, Cherry, and Cairns (1983) | 28-day exposure duration | *Corbicula fluminea* |
| 54 53<br>87 48<br>70 57<br>35 44 | Jones, Jones and Radlett (1976) | 25-day exposure duration | *Nereis diversicolor* |
| 800 | Majori and Petronio (1973) | 8-day exposure duration | *Mytilus galloprovincialis* |
| 104<br>2,792 | McLusky and Phillips (1975) | 21-day exposure duration | *Phylloduce maculata* |
| 37 40<br>43 42 | Nehring (1976) | 14-day exposure duration; the value reported was converted to wet weight using a conversion factor of 5.99[(a)]. | *Pteronarcys californica* |
| 2,462 | Pesch and Morgan (1978) | 28-day exposure duration | *Nereis arenaceodentata* |
| 35 185.5<br>69 26.5 | Phillips (1976) | 35-day exposure duration; the reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)], a conversion factor of $1 \times 10^3$ was applied to the value. | *Mytilus edulis* |
| 5,160 11,800<br>6,800 19,000<br>11,560 27,800<br>12,540 22,500 | Shuster and Pringle (1968) | 35, 70, 105, and 140-day exposure duration | *Crassostrea virginica* |
| 160 | Pringle, Hissong, Katz, and Mulawka (1968) | 70-day exposure duration | *Mya arenaria* |
| Compound: Cyanide (total) | | | Recommended BCF Value: 4,066 |
| Laboratory data were not available for this constituent. The recommended BCF is the arithmetic mean of the recommended values for 14 inorganics with laboratory data available (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc). | | | |
| Compound: Lead | | | Recommended BCF Value: 5,059 |
| The BCF value was calculated using the geometric mean of 6 field values as follows: | | | |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 8,076 7,237<br>3,636 3,575<br>5,671 3,890 | Nehring, Nisson, and Minasian (1979) | Field samples. | *Tipulidae*; *Para quetina* sp.; *Heptageniidae; Nemoura* sp.; *Macronenum* sp.; *Anisoptera* |
| 2500 | Borgmann, Kramar, and Loveridge (1978) | 120-day exposure duration | *Lymnaea palustris* |
| 357 | Eisler (1977) | 14-day exposure duration | *Mya arenara* |
| 111 50<br>63 71<br>63 | Nehring (1976) | 14-day exposure duration; the reported value was converted from dry weight to wet weight using a conversion factor of 5.99[(a)]. | *Petronarcys californica* |
| 1520 502.5<br>765 555 | Phillips (1976) | 35-day exposure duration; the reported value was calculated by dividing the wet tissue concentration by the medium concentration [(µg/g)/(µg/L)], and an unit conversion factor of 1 x $10^3$ was applied to the value. | *Mytilus edulis* |
| 578<br>1,097 | Zaroogian, Morrison, Heltshe (1979) | 20-day exposure duration; The reported value was calculated by dividing the dry tissue concentration by the medium concentration [(µg/g)/(µg/kg)], and an unit conversion factor of 1 x $10^3$ was applied to the value. A conversion factor or 5.99[(a)] was used to convert dry weight to wet weight. | *Crassostrea virginica* |
| Compound: Mercuric chloride | | | Recommended BCF Value: 20,184 |
| The BCF value was based on 6 laboratory values as follows: | | | |
| 100,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Marine and freshwater invertebrates |
| 12,000 | Kopfter (1974) | 74-day exposure duration; the reported value was calculated by dividing the dry tissue concentration by the medium concentration [(ppm)/(ppb)], and an unit conversion factor of 1 x $10^3$ was applied to the value. | *Crassostrea virginica* |
| 13,633 14,600<br>14,217 19,916 | Thurberg, Calabrese, Gould, Greig, Dawson, and Tucker (1977) | 30 to 60-day exposure duration; The reported value was calculated by dividing the dry tissue concentration by the medium concentration [(ppm)/(ppb)], and an unit conversion factor of 1 x $10^3$ was applied to the value. | *Homarus americanus* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Methyl mercury | | | Recommended BCF Value: 55,000 |
| The BCF value was based on 1 laboratory value as follows: | | | |
| 55,000 | Kopfter (1974) | 74-day exposure duration; The reported value was calculated by dividing the dry tissue concentration by the medium concentration [(ppm)/(ppb)] and a conversion factor of 1 x $10^3$ was applied to the value. | *Crassostrea virginica* |
| Compound: Nickel | | | Recommended BCF Value: 28 |
| The BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 100<br>250 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater and marine invertebrates |
| 2<br>12 | Watras, MacFarlane, and Morel (1985) | Reported values adopted from a high and low range. | *Daphnia magna* |
| Compound: Selenium | | | Recommended BCF Value: 1,262 |
| The BCF value was calculated using the geometric mean of 5 laboratory values as follows: | | | |
| 229,000 | Besser, Canfield, and LaPoint (1993) | 96-hour exposure duration | *Daphnia magna* |
| 90<br>930 | Hermanutz, Allen, Roush, and Hedtke (1992) | 365-day exposure duration | *Lepomis macrochirus* |
| 167<br>1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater and marine invertebrates |
| Compound: Silver | | | Recommended BCF Value: 298 |
| The BCF value was calculated using the geometric mean of 12 laboratory values as follows: | | | |
| 1,391 5,100<br>2,203 1,056<br>6,500 1,435 | Calabrese, MacInnes, Nelson, Greig, and Yevich (1984) | 540 to 630 day exposure duration; he reported value was calculated by dividing the wet tissue concentration by the medium concentration [(mg/kg)/(µg/L)], and an unit conversion factor of 1 x $10^3$ was applied to the value. | *Mytilus edulis* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 1,711 | Metayer, Amiard-Triquet and Baud (1990) | 14-day exposure duration | *Crassostrea gigas* |
| 30<br>22<br>18 13<br>12 | Nehring (1976) | 14-day exposure duration; the reported value in Nehring (1976) was converted from dry weight to wet weight using a conversion factor of 5.99[a]. | *Pteronarcys californica* |
| Compound: Thallium | | | Recommended BCF Value: 15,000 |
| The BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 15,000<br>15,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater and marine invertebrates |
| Compound: Zinc | | | Recommended BCF Value: 4,578 |
| The BCF value was calculated using the geometric mean of 9 field values as follows: | | | |
| 30,036 | Namminga and Wilhm (1977) | Field samples. | *Chironomidae* sp. |
| 2,613<br>2,199<br>1,282<br>3,210 4,718<br>6,625<br>3,876<br>10,274 | Saiki, Castleberry, May, Martin, and Bullard (1995) | Field samples; the reported value was converted from dry weight to wet weight using a conversion factor of 5.99[a]. | *Chironomidae* sp.; *Ephemeroptera* sp. |
| 50<br>3,000 | Deutch, Borg, Kloster, Meyer, and Moller (1980) | 9-day exposure duration | Marine invertebrates |
| 143 | Eisler (1977) | 14-day exposure duration | *Mya arenaria* |
| 358<br>511<br>631 | Graney, Cherry, and Cairns (1983) | 28-day exposure duration | *Corbicula fluminea* |
| 499<br>326<br>159<br>92<br>43 95<br>53<br>25<br>15<br>7 | Nehring (1976) | 14-day exposure duration; the reported value was converted from dry weight to wet weight using a conversion factor of 5.99[a]. | *Ephemerella grandis*; *Pteronarcys californica* |

## TABLE C-3

## WATER-TO-AQUATIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 519 2,615<br>315 184 | Phillips (1976) | 35-day exposure duration | Mytilus edulis |
| 85 | Pringle, Hissong, Katz, and Mulawka (1968) | 50-day exposure duration | *Mya arenaria* |

Notes:

(a) The reported values are presented as the amount of COPC in invertebrate tissue divided by the amount of COPC in the water. If the values reported in the studies were presented as dry tissue weight over amount of COPC in water, they were converted to wet weight by dividing the concentration in dry invertebrate tissue weight by 5.99. This conversion factor assumes an invertebrate's total weight is 83.3 percent moisture, which is based on the moisture content of the earthworm (Pietz et al. 1984).

The conversion factor was calculated as follows:

$$Conversion\ factor = \frac{1.0\ gram\ (g)\ invertebrate\ total\ weight}{1.0\ gram\ (g)\ invertebrate\ total\ weight\ -\ 0.833\ g\ invertebrate\ wet\ weight}$$

(b) Reported field values for organic COPCs are assumed to be total COPC concentration in water and, therefore, were converted to dissolved COPC concentration in water using the following equation from U.S.EPA (1995b):

$BCF\ (dissolved) = (BCF\ (total) / f_{fd}) - 1$

where: BCF (dissolved) = BCF based on dissolved concentration of COPC in water
BCF (total) = BCF based on the field derived data for total concentration of COPC in water
$f_{fd}$ = Fraction of COPC that is freely dissolved in the water

where: $f_{fd} = 1 / [1 + ((DOC \times K_{ow}) / 10) + (POC \times K_{ow})]$
DOC = Dissolved organic carbon, kilograms of organic carbon / liter of water ($2.0 \times 10^{-06}$ Kg/L)
$K_{ow}$ = Octanol-water partition coefficient of the COPC, as reported in U.S. EPA (1994b)
POC = Particulate organic carbon, kilograms of organic carbon / liter of water ($7.5 \times 10^{-09}$ Kg/L)

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) | | | Recommended BCF value: 3,302 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 4,000<br>9,000 | Yockim, Isensee, and Jones (1978) | Values adopted from a high to low range; reported values were for 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD). | *Leona minor* |
| 1,000 | Yockim, Isensee, and Jones (1978) | 32-day exposure duration; reported values were for 2,3,7,8-TCDD. | *Oedogonium cardiacum* |
| Compound: 1,2,3,7,8-Pentachlorodibenzo(p)dioxin (1,2,3,7,8-PeCDD) | | | Recommended BCF value: 3,038 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.92 = 3,038 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,4,7,8-HxCDD) | | | Recommended BCF value: 1,024 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.31 = 1,024 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,6,7,8-HxCDD) | | | Recommended BCF value: 396.2 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.12 = 396.2 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo(p)dioxin (1,2,3,7,8,9-HxCDD) | | | Recommended BCF value: 462.3 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.14 = 462.3 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo(p)dioxin (1,2,3,4,6,7,8-HpCDD) | | | Recommended BCF value: 168.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.051 = 168.4 | | | |
| Compound: Octachlorodibenzo(p)dioxin (OCDD) | | | Recommended BCF value: 39.6 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.012 = 39.6 | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF) | | | Recommended BCF value: 2,642 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.80 = 2,642 | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzofuran 1,(2,3,7,8-PeCDF) | | | Recommended BCF value: 726.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x0.22 =726.4 | | | |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: 2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF) | | | Recommended BCF value: 5,283 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 1.6 = 5,283 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF) | | | Recommended BCF value: 251.0 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.076 = 251.0 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-HxCDF) | | | Recommended BCF value: 627.4 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.19 = 627.4 | | | |
| Compound: 2,3,4,6,7,8-Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF) | | | Recommended BCF value: 2,212 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.67 = 2,212 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-HxCDF) | | | Recommended BCF value: 2,080 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.63 = 2,080 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF) | | | Recommended BCF value: 36.3 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.011 = 36.3 | | | |
| Compound: 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF) | | | Recommended BCF value: 1,288 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.39 = 1,288 | | | |
| Compound: Octachlorodibenzofuran (OCDF) | | | Recommended BCF value: 52.8 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF = 3,302 x 0.016 = 52.8 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF value: 5,258 |
| The recommended BCF value was based on a single measured value for benzo(a)pyrene. This value was also used as a surrogate for all high molecular weight PAHs for which laboratory data were not available. | | | |
| 5,258 | Lu, Metcalf, Plummer, and Mandel (1977) | 3-day exposure duration | *Oedogonium cardiacum* |
| Compound: Benzo(a)anthracene | | | Recommended BCF value: 5,258 |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(b)fluoranthene | | | Recommended BCF value: 5,258 |
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF value: 5,258 |
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Chrysene | | | Recommended BCF value: 5,258 |
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Dibenz(a,h)anthracene | | | Recommended BCF value: 5,258 |
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF value: 5,258 |
| Laboratory data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF value: 476,829 |
| The reported value was calculated by dividing the wet tissue concentration by the medium concentration (ppm/pptr). A conversion factor of 1 x $10^6$ was applied to the value. The BCF value is based on Aroclor 1254 since there was no available data for total PCB. | | | |
| 476,829 | Scura and Theilacker (1977) | 45-day exposure to Aroclor 1254 | *Dunaliella* sp. |
| Compound: Aroclor 1254 | | | Recommended BCF value: 476,829 |
| The reported value was calculated by dividing the wet tissue concentration by the medium concentration (ppm/pptr). A conversion factor of 1 x $10^6$ was applied to the value. The BCF value is based on Aroclor 1254 since there was no available data for total PCB. | | | |
| 476,829 | Scura and Theilacker (1977) | 45-day exposure to Aroclor 1254 | *Dunaliella* sp. |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF value: 2,507 |
| Laboratory data were not available for this compound. The BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF value: 2,507 |
| The recommended BCF value was based on one study as follows: | | | |
| 2,507 | Liu, Bailey, and Pearson (1983) | 4-day exposure duration | *Selanastrum capricornatum* |
| Compound: 2,6-Dinitrobenzene | | | Recommended BCF value: 2,507 |
| Laboratory data were not available for this compound. The BCF for 2,4-dinitrotoluene was used as a surrogate. | | | |
| Compound: Nitrobenzene | | | Recommended BCF value: 24 |
| The recommended BCF value was based on one study as follows: | | | |
| 24 | Geyer, Viswanathan, Freitag, and Korte (1981) | 1-day exposure duration | *Chlorella fusca* |
| Compound: Pentachloronitrobenzene | | | Recommended BCF value: 4,740 |
| The recommended BCF value calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 3,100 | Geyer, Viswanathan, Freitag, and Korte (1981) | 1-day exposure duration | *Chlorella fusca* |
| 4,795<br>7,534 | Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) | 1-day exposure duration; The values reported in Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) were converted to wet weight using a conversion factor of 2.92 [a]. | *Chlorella fusca* |
| 4,508 | Wang, Harada, Watanabe, Koshikawa, and Geyer (1996) | Not reported | *Chlorella fusca* |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF value: 9,931 |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| The recommended BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 5,400 | Geyer, Viswanathan, Freitag, and Korte (1981) | 1-day exposure duration | *Chlorella fusca* |
| 18,263 | Sodergren (1982) | 27-day exposure duration | *Chara chara* |
| Compound: Di(n)octyl phthalate | | | Recommended BCF value: 28,500 |
| The recommended BCF value was based on one study as follows: | | | |
| 28,500 | Sanborn, Metcalf, Yu, and Lu (1975) | 33-day exposure duration | *Oedogonium cardiacum* |
| **Volatile Organic Compounds** | | | |
| Compound: Acetone | | | Recommended BCF value: 0.05 |
| Laboratory data were not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.222 (Karickoff and Long 1995) | | | |
| Compound: Acrylonitrile | | | Recommended BCF value: 0.11 |
| Laboratory data are not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.250 (Karickoff and Long 1995) | | | |
| Compound: Chloroform | | | Recommended BCF value: 2.82 |
| Laboratory data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.949 (U.S. EPA 1994b) | | | |
| Compound: Crotonaldehyde | | | Recommended BCF value: 0.20 |
| Laboratory data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.55 (based on equation developed by Hansch and Leo 1979, calculated in NRC (1981)) | | | |
| Compound: 1,4-Dioxane | | | Recommended BCF value: 0.04 |
| Laboratory data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.268 (U.S. EPA 1995a) | | | |
| Compound: Formaldehyde | | | Recommended BCF value: 0.14 |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Laboratory data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.342 (U.S. EPA 1995a) | | | |
| Compound: Vinyl chloride | | | Recommended BCF value: 0.62 |
| Laboratory data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.146 (U.S. EPA 1994b) | | | |
| **Other Chlorinated Organics** | | | |
| Compound: Carbon tetrachloride | | | Recommended BCF value: 300 |
| The recommended BCF value was based on laboratory data as follows: | | | |
| 300 | Geyer, Politzki and Freitag (1984) | 1-day exposure duration | *Chlorella fusca* |
| Compound: Hexachlorobenzene | | | Recommended BCF value: 11,134 |
| The recommended BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 24,800 | Geyer, Politzki, and Freitag (1984) | 1-day exposure duration | *Chlorella fusca* |
| 610 | Isensee, Holden, Woolson and Jones (1976) | 31-day exposure duration | *Oedogonium cardiacum* |
| 41,096 | Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) | 1-day exposure duration; the values reported in Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) were converted to wet weight using an unit conversion factor of 2.92 [a]. | *Chlorella fusca* |
| 24,717 | Wang, Harada, Watanabe, Koshikawa, and Geyer (1996) | Not reported | *Chlorella fusca* |
| Compound: Hexachlorobutadiene | | | Recommended BCF value: 160 |
| The recommended BCF value calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 160 | Laseter, Bartell, Laska, Holmquist, Condie, Brown, and Evans (1976) | 7-day exposure duration | *Oedogonium cardiacum* |
| 160 | U.S. EPA (1976) | Not reported | Algae |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF value: 610 |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| The recommended BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 1,090 | Geyer, Viswanathan, Freitag, and Korte (1981) | Not reported | *Chlorella fusca* |
| 341 | Lu, Metcalf, Hirwe, and Williams (1975) | Not reported | *Oedogonium cardiacum* |
| Compound: Pentachlorobenzene | | | Recommended BCF value: 4,000 |
| The recommended BCF value was based on one study as follows: | | | |
| 4,000 | Geyer, Politzki, and Freitag (1984) | 1-day exposure duration | *Chlorella fusca* |
| Compound: Pentachlorophenol | | | Recommended BCF value: 1,711 |
| The recommended BCF value calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 1,250 | Geyer, Viswanathan, Freitag, and Korte (1981) | 1-day exposure duration | *Chlorella fusca* |
| 2,055<br>2,534<br>1,781 | Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) | 1-day exposure duration; the values reported in Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) were converted to wet weight using an unit conversion factor of 2.92[a]. | *Chlorella fusca* |
| 1,266 | Wang, Harada, Watanabe, Koshikawa, and Geyer (1996) | Not reported | *Chlorella fusca* |
| **Pesticides** | | | |
| Compound: 4,4'-DDE | | | Recommended BCF value: 11,251 |
| The recommended BCF value was based on one study as follows: | | | |
| 11,251 | Metcalf, Sanborn, Lu, and Nye (1975) | 33-day exposure duration | *Oedogonium cardiacum* |
| Compound: Heptachlor | | | Recommended BCF value: 21,000 |
| The recommended BCF value was based on one study as follows: | | | |
| 21,000 | U.S. EPA (1979) | Not reported | Algae |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Hexachlorophene | | | Recommended BCF value: 1,500 |
| The recommended BCF value was based on one study as follows: | | | |
| 1,500 | Sanborn (1974) | Not reported | Algae |
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF value: 833 |
| The recommended BCF value was based on one study as follows: | | | |
| 600 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Algae (marine plants) |
| Compound: Antimony | | | Recommended BCF value: 1,475 |
| The recommended value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 1,500<br>1,450 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Arsenic | | | Recommended BCF value: 293 |
| The recommended value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 5 | Anderson et al. (1979) | 42-day exposure duration | *Lemna minor* |
| 3,000<br>1,670 | Thompson, Burton, Quinn, and Ng 1972 | Not reported | Not reported |
| Compound: Barium | | | Recommended BCF value: 260 |
| The recommended BCF value was based on one study as follows: | | | |
| 260 | Schroeder (1970) | Not reported | Brown algae |
| Compound: Beryllium | | | Recommended BCF value: 141 |
| The recommended value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 20<br>1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Cadmium | | | Recommended BCF value: 782 |
| The recommended BCF value was calculated using the geometric mean of 6 laboratory values as follows: | | | |
| 300<br>1,000<br>370<br>1,000 | Fisher, Bohe, and Teyessie (1984) | Not reported | *Thalassiosira pseudonana*<br>*Dunaliella tertiolecta*<br>*Emiliania huxleyi*<br>*Oscillatoria woronichinii* |
| 2,065 | Hutchinson and Czyrska (1972) | 21-day exposure duration; The values reported in Hutchinson and Czyrska (1972) were converted to wet weight using a conversion factor of 2.92[a]. | *Lemna valdiviana* |
| 1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Chromium (total) | | | Recommended BCF value: 4,406 |
| The recommended BCF value was calculated using the geometric mean of 8 laboratory values as follows: | | | |
| 343 | Jouany, Vasseur, and Ferard (1982) | 28-day exposure duration; the values reported in Jouany, Vasseur, and Ferard (1982) were converted to wet weight using an unit conversion factor of 2.92[a]. | *Chlorella vulgaris* |
| 1,600 | NAS (1974) | Not reported | Benthic algae |
| 26,316<br>8,485<br>29,000<br>5,000 | Patrick, Bott, and Larson (1975) | 4 experiments consisting of 1-month exposure durations | Mixed algae |
| 4,000<br>2,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Copper | | | Recommended BCF value: 541 |
| The recommended BCF value was calculated using the geometric mean of 5 laboratory values as follows: | | | |
| 17 | Bastien and Cote (1989) | 50-day exposure duration | *Scenedesmus quadricauda* |
| 827<br>1,644 | Stokes, Hutchinson, and Krauter (1973) | 2-day exposure duration | *Scenedesmus* sp. |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 2,000<br>1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Freshwater and marine plants |
| Compound: Cyanide (total) | | | Recommended BCF value: 22 |
| The recommended BCF value was based on one study as follows: | | | |
| 22 | Low and Lee (1981) | 72-hour exposure duration | *Eichhornia crassipes* |
| Compound: Lead | | | Recommended BCF value: 1,706 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 100<br>5,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| 9,931 | Vighi (1981) | 28-day exposure duration; the values reported in Vighi (1981) were converted to wet weight using an unit conversion factor of 2.92[a]. | *Selenastrum capricornutum* |
| Compound: Mercury chloride | | | Recommended BCF value: 24,762 |
| The recommended BCF value was based on one study as follows: | | | |
| 24,762 | Watras and Bloom (1992) | Field samples | Phytoplankton |
| Compound: Methyl mercury | | | Recommended BCF value: 80,000 |
| The recommended BCF value was based on one study as follows: | | | |
| 80,000 | Watras and Bloom (1992) | Field samples | Phytoplankton |
| Compound: Nickel | | | Recommended BCF value: 61 |
| The recommended BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 32<br>34 | Hutchinson and Stokes (1975) | 6-day exposure duration | *Scenedesmus* sp. |
| 50<br>250 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Selenium | | | Recommended BCF value: 1,845 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 15,700 | Besser, Canfield, and LaPoint (1993) | 24-hour exposure duration | *Chlamydomonas reinhardtii* |
| 400 | Dobbs, Cherry, and Cairns (1996) | 25-day exposure duration | *Chlorella vulgaris* |
| 1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Silver | | | Recommended BCF value: 10,696 |
| The recommended BCF value was calculated using the geometric mean of 5 laboratory values as follows: | | | |
| 34,000<br>13,000<br>24,000<br>66,000 | Fisher, Bohe, and Teyssie (1984) | Not reported | *Thalassiosira pseudonana*<br>*Dunaliella tertiolecta*<br>*Emiliania huxleyi*<br>*Oscillatoria woronichinii* |
| 200 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Thallium | | | Recommended BCF value: 15,000 |
| The recommendedBCF was based on one study as follows: | | | |
| 15,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |
| Compound: Zinc | | | Recommended BCF value: 2,175 |
| The recommended BCF value was calculated using the geometric mean of 17 laboratory values as follows: | | | |
| 285<br>4,395 | Andryushhenko and Polikarpou (1973) | 5-day exposure duration | *Ulva rigida* |
| 4,680 | Baudin (1974) | 34-day exposure duration | *Cladophoea* |
| 70<br>600<br>1,200<br>1,400<br>170,000 | Deutch, Borg, Kloster, Meyer, and Moller (1980) | 9-day exposure duration | *Codium fragile*<br>*Enteromorpha* sp.<br>*Ulva lactuca*<br>*Fucus serratus*<br>Marine plankton |

## TABLE C-4

## WATER-TO-ALGAE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 12,000<br>10,000<br>4,600<br>5,200 | Fisher, Bohe, and Teyssie (1984) | Not reported | *Thalassiosira pseudonana*<br>*Dunaliella tertiolecta*<br>*Emiliania huxleyi*<br>*Oscillatoria woronichinii* |
| 524<br>1,015 | Munda (1979) | 12-day exposure; The values reported in Munda (1979) were converted to wet weight using a conversion factor of 2.92 [a]. | *Enteromorpha prolifera*<br>*Fucus vivsoides* |
| 255 | U.S. EPA (1987a) | 6-day exposure duration | *Ulva lactuca* |
| 20,000<br>1,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Not reported |



Notes:

(a) The reported values are presented as the amount of COPC in algae divided by the amount of COPC in water. If the values reported in the studies were presented as dry tissue weight over the amount of COPC in water, they were converted to wet weight over dry weight by dividing the concentration in dry algae tissue weight by 2.92. This conversion factor assumes an algae total weight is 65.7 percent moisture (Isensee, Kearney, Woolson, Jones and Williams 1973). The conversion factor was calculated as follows:

$$Conversion\ factor = \frac{1.0\ g\ algae\ total\ weight}{1.0\ g\ algae\ total\ weight\ -\ 0.675\ g\ algae\ wet\ weight}$$

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-Tetrachlorinated dibenzo(p)dioxin (2,3,7,8-TCDD) | | | Recommended BCF value: 4,235 |
| The recommended value was calculated using the geometric mean of 12 laboratory values for several PCDD compounds as follows: | | | |
| 5,800 | Adams, DeGraeve, Sabourin, Cooney, and Mosher (1986) | 28-day exposure duration, 20-day elimination; reported data were for 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) | *Pimephales promelas* |
| 9,270 | Branson, Takahashi, Parker, and Blau (1985) | 6-hour exposure duration, 139-day depuration | *Oncorhynchus mykiss* |
| 39,000 | Mehrle, Buckler, Little, Smith, Petty, Peterman, Stalling, DeGraeve, Coyle, and Adams (1988) | 28-day exposure duration | *Oncorhynchus mykiss* |
| 810<br>2,840<br>513<br>5,834 | Muir, Marshall, and Webster (1985) | 4 to 5-day exposure duration, 24 to 28-day depuration; values are based on a high to low range of reported values. | *Oncorhynchus mykiss*<br>*Pimephales promelas* |
| 2,769<br>2,269 | Yockim, Isensee, and Jones (1978) | 15-day exposure duration | *Gambusia affinis*<br>*Ictalurus* sp. |
| 5,000<br>9,300<br>7,900 | U.S. EPA (1985) | Not reported | *Pimephales promelas* |
| Compound: 1,2,3,7,8-Pentachlorodibenzo(p)dioxin (1,2,3,7,8-PeCDD) | | | Recommended BCF value: 3,896 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.92 =3,896 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,4,7,8-HxCDD) | | | Recommended BCF value: 1,313 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.31 =1313 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo(p)dioxin (1,2,3,6,7,8-HxCDD) | | | Recommended BCF value: 508.2 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.12 =508.2 | | | |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo(p)dioxin (1,2,3,7,8,9-HxCDD) | | | Recommended BCF value: 592.9 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.14 =592.9 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo(p)dioxin (1,2,3,4,6,7,8-HpCDD) | | | Recommended BCF value: 215.9 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.051 =215.9 | | | |
| Compound: Octachlorodibenzo(p)dioxin (OCDD) | | | Recommended BCF value: 50.8 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.012 =50.8 | | | |
| Compound: 2,3,7,8-Tetrachlorinated dibenzofuran (2,3,7,8-TCDF)Compound: | | | Recommended BCF value: 3,388 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.80 =3,388 | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzo(p)furan (1,2,3,7,8-PeCDF) | | | Recommended BCF value: 931.7 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.22 =931.7 | | | |
| Compound: 2,3,4,7,8-Pentachlorodibenzo(p)furan (2,3,4,7,8-PeCDF) | | | Recommended BCF value: 6,776 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x1.6 =6,776 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo(p)furan (1,2,3,4,7,8-HxCDF) | | | Recommended BCF value: 3,21.9 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.076 =3,21.9 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo(p)furan (1,2,3,6,7,8-HxCDF) | | | Recommended BCF value: 804.7 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.19 =804.7 | | | |
| Compound: 2,3,4,6,7,8-Hexachlorodibenzo(p)furan (2,3,4,6,7,8-HxCDF) | | | Recommended BCF value: 2,837 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.67 = 2,837 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo(p)furan (1,2,3,7,8,9-HxCDF) | | | Recommended BCF value: 2,668 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.63 =2,668 | | | |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: 1,2,3,4,6,7,8,-Heptachlorodibenzo(p)furan (1,2,3,4,6,7,8-HpCDF) | | | Recommended BCF value: 46.6 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.011 =46.6 | | | |
| Compound: 1,2,3,4,7,8,9-Heptachlorodibenzo(p)furan (1,2,3,4,7,8,9-HpCDF) | | | Recommended BCF value: 1,651 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.39 =1,651 | | | |
| Compound: Octachlorodibenzo(p)furan (OCDF) | | | Recommended BCF value: 67.8 |
| The BCF was calculated using the TCDD BCF and a bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =4,235 x 0.016 =67.8 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF value: 500 |
| The recommended value is that presented in Stephan (1993), which was the geometric mean of 16 laboratory values. This BCF for benzo(a)pyrene is also recommended for high molecular weight PAH for which empirical data are not available. | | | |
| 500 | Stephan (1993) | Not reported | Not reported |
| Compound: Benzo(a)anthracene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(b)fluoranthene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Chrysene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Dibenz(a,h)anthracene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF value: 500 |
| Empirical data were not available for this compound. The BCF for benzo(a)pyrene was used as a surrogate. | | | |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF value: 22,649 |
| The recommended BCF value was calculated using the geometric mean of 4 field values as follows[b, c, d]: | | | |
| 25,000 | Hansen et al. (1975) as cited in U.S. EPA (1980b) | 28 days exposure<br>1.1 percent lipid<br>Adult | *Cyprinodon variegatus* |
| 43,000 | Hansen et al. (1975) as cited in U.S. EPA (1980b) | 28 days exposure<br>Whole body<br>Juvenile | *Cyprinodon variegatus* |
| 14,400 | Hansen et al. (1975) as cited in U.S. EPA (1980b) | 28 days exposure<br>Whole body<br>Fry | *Cyprinodon variegatus* |
| 17,000 | Hansen et al. (1974) as cited in U.S. EPA (1980b) | 21 to 28 days exposure<br>Whole body | *Lagodon rhomboides* |
| Compound: Aroclor 1254 | | | Recommended BCF value: 230,394 |
| The recommended BCF value was calculated using the geometric mean of 7 field values as follows[b, c, d]: | | | |
| 238,000 females<br>235,000 males | Nebeker, Puglisi, and DeFoe (1974) | Fish exposed for eight months. Residues measured in males and females. | *Pimephales promeles* |
| 35,481<br>354,813<br>281,838 | Rice and White (1987) | Field study | *Pimephales promeles* |
| 46,000 | Bills and Marking (1987) | 30-day exposure duration<br>Whole body | *Oncorhynchus mykiss* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 13,000,000 in lipid<br>1,030,000 dry tissue | Scura and Theilacker (1977) | 45 days exposure | *Engraulis mordex* |
| 370,000<br>1,200,000 | Veith et al. (1977) | Field samples | Sculpins (bottom fish)<br>Pelagic fish |
| 47,000 | Mauck et al. (1978) as cited in U.S. EPA (1980b) | 118 days exposure<br>Whole body | *Salvellnus fontinalis* |
| 42,000 | Snarski and Puglisi (1976) as cited in U.S. EPA (1980b) | 500 days exposure<br>Body lipid 2.9 percent<br>Whole body | *Salvellnus fontinalis* |
| 37,000 | Hansen et al. (1971) as cited in EPA (1980b) | 28 days exposure<br>1.1 percent lipid<br>Whole body | *Leiostomus xanthurus* |
| 30,000 | Hansen et al. (1973) as cited in EPA (1980b) | 28 days exposure<br>3.6 percent lipid<br>Whole body | *Cyprinodon variegatus* |
| >670,00 | Duke et al. (1970) and Nimmo et al. (1977) as cited in EPA (1980b) | Field data<br>Whole body | *Cynoscion nebulosus* |
| >133,000 | Nimmo et al. (1977) as cited in EPA (1980b) | Field data | Fishes |
| 38,000 | Halter (1974) as cited in EPA (1980b) | 24 days exposure | *Salmo gairdneri* |
| 61,200 | Mayer et al. (1977) as cited in EPA (1980b) | 77 days exposure<br>Whole body | *Ictalurus punctatus* |
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF value: 74 |
| The BCF for 1,3 -dinitrobenzene was based on one laboratory value as follows: | | | |
| 74 | Deener, Sinnige, Seinen, and Hemens (1987) | 3-day exposure duration | *Poecilia reticulata* |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF value: 21.04 |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Empirical data for this compound were not available. The BCF for nitrobenzene was used as a surrogate. | | | |
| Compound: 2,6-Dinitrotoluene | | | Recommended BCF value: 21.04 |
| Empirical data for this compound were not available. The BCF for nitrobenzene used as a surrogate. | | | |
| Compound: Nitrobenzene | | | Recommended BCF value: 21.04 |
| The recommended BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 29.5 | Deneer, Sinnige, Seinen, and Hermens (1987) | 3-day exposure duration | *Poecilia reticulata* |
| 15 | Veith, DeFoe, and Bergstedt (1979) | 28-day exposure duration | *Pimephales promelas* |
| Compound: Pentachloronitrobenzene | | | Recommended BCF value: 214 |
| The recommended BCF value was calculated using the geometric mean of 7 laboratory values as follows: | | | |
| 238 | Kanazawa (1981) | Continuous flow test | *Pseudorasbora parva* |
| 250<br>320<br>380 | Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) | 24-hr exposure duration | *Leucisens idus melanotus* |
| 114<br>147<br>169 | Niimi, Lee, and Kissoon (1989) | 20, 28, and 36-day exposure duration | *Oncorhynchus mykiss* |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF value: 70 |
| The recommended BCF value was calculated using the geometric mean of 14 laboratory values as follows: | | | |
| 91<br>569 | Mayer (1976) | 56-day exposure duration; based on a high to low range of reported values. | *Pimephales promelas* |
| 155<br>42 | Mehrle and Mayer (1976) | 36 to 56-day exposure | *Pimephales promelas*<br>*Oncorhynchus mykiss* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 178<br>10,563<br>306 | Sodergren (1982) | 27-day exposure duration | *Phoxinus phoxinus*<br>*Lampetra planeri*<br>*Pungitis pungitis* |
| 51.5<br>8.9<br>1.6 | Tarr, Barron, and Hayton (1990) | Not reported | *Salmo gairdneri* |
| 4 | U.S. EPA (1992a) | Not reported | Fish |
| 851 | Veith, DeFoe, and Bergstedt (1979) | Not reported | *Pimephales promelas* |
| 10.7<br>13.5 | Wofford, Wilsey, Neff, Giam, and Neff (1981) | 24-hour exposure duration | *Cypinodon variegatus* |
| Compound: Di(n)octyl phthalate | | | Recommended BCF value: 9,400 |
| The recommended BCF value was based on data from one study as follows: | | | |
| 9,400 | Sanborn, Metcalf, Yu, and Lu (1975) | Not reported | *Gambusia affinis* |
| **Volatile Organic Compounds** | | | |
| Compound: Acetone | | | Recommended BCF value: 0.10 |
| Empirical data were not available for this compound. The BCF was calculated using the following regression equation:<br>log BCF = 0.91 x log $K_{ow}$ - 1.975 x log(6.8E-07 x $K_{ow}$ + 1.0) - 0.786 (Bintein et al. 1993), where log $K_{ow}$ = -0.222 (Karickoff and Long 1995) | | | |
| Compound: Acrylonitrile | | | Recommended BCF value: 48 |
| The recommended BCF value was based on data from one study as follows: | | | |
| 48 | Barrows, Petrocelli, Macek, and Carroll (1978) | 28-day exposure duration | *Lepomis macrochirus* |
| Compound: Chloroform | | | Recommended BCF value: 3.59 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values follows: | | | |
| 5.6<br>3.44<br>2.4 | Anderson and Lusty (1980) | 24-hr exposure, 24-hr depuration | *Oncorhynchus mykiss*<br>*Leponis macrochinus*<br>*Micropterus salmoides* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Crotonaldehyde | | | Recommended BCF value: 0.52 |
| Empirical data were not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.91 x log $K_{ow}$ - 1.975 x log(6.8E-07 x $K_{ow}$ + 1.0) - 0.786 (Bintein et al. 1993), where log $K_{ow}$ = 0.55 (based on equation in Hansch and Leo 1979, as calculated in NRC (1981)). | | | |
| Compound: Formaldehyde | | | Recommended BCF value: 0.34 |
| Empirical data were not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.91 x log $K_{ow}$ - 1.975 x log(6.8E-07 x $K_{ow}$ + 1.0) - 0.786 (Bintein et al. 1993), where log $K_{ow}$ = 0.342 (U.S. EPA 1995a) | | | |
| Compound: Vinyl chloride | | | Recommended BCF value: 1.81 |
| Empirical data were not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.91 x log $K_{ow}$ - 1.975 x log(6.8E-07 x $K_{ow}$ + 1.0) - 0.786 (Bintein et al. 1993), where log $K_{ow}$ =1.146 (U.S. EPA 1994b) | | | |
| **Other Chlorinated Organics** | | | |
| Compound: Carbon tetrachloride | | | Recommended BCF value: 30 |
| The recommended BCF value was based on 1 laboratory values as follows: | | | |
| 30 | Barrows, Petrocelli, Macek, and Carroll (1978) | 28-day exposure duration | *Lepomis macrochirus* |
| Compound: Hexachlorobenzene | | | Recommended BCF value: 253 |
| The recommended BCF value on 1 field value as follows[b, c] | | | |
| 253 | Oliver and Niimi (1988) | Field samples. | Freshwater fish |
| 22,000 | Carlson and Kosian (1987) | 32-day exposure duration | *Pimephales promelas* |
| 1,260<br>2,040<br>6,160<br>15,850 | Isensee, Holden, Woolson, and Jones (1976) | 31-day exposure duration | *Gambusia affinis*<br>*Ictalurus punctatus* |
| 290,000 | Koneman and van Leeuwen (1980) | Not reported | *Poecilia reticulata* |
| 400<br>420 | Korte, Freitag, Geyer, Klein, Kraus, and Lahaniatis (1978) | 1-day exposure duration | *Zeucisens idus melanotus* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 32,000<br>39,000 | Kosian, Lemke, Studders, and Veith (1981) | 28-day exposure duration | *Pimephales promelas* |
| 5,200<br>6,970 | Lores, Patrick, and Summers (1993) | 30-day exposure duration; based on a high to low range of reported values. | *Cyprinodon variegatus* |
| 93<br>287 | Metcalf, Kapoor, Lu, Schuth, and Sherman (1973) | 3 to 32-day exposure duration | *Gambusia affinis* |
| 12,240 12,600<br>15,250 13,330<br>21,140 | Nebeker, Griffis, Wise, Hopkins, and Barbittas (1989) | 28-day exposure duration | *Pimephales promelas* |
| 253,333 | Oliver and Niimi (1983) | 119-day exposure duration | *Oncorhynchus mykiss* |
| 27,000 | Schrap and Opperhuizen (1990) | Not reported | *Poecilia reticulata* |
| 18,500 | Veith, DeFoe, and Bergstedt (1979) | 32-day exposure duration | *Pimephales promelas* |
| 7,800 | U.S. EPA (1987) | Not reported | *Oncorhynchus mykiss* |
| 8,690 | U.S. EPA (1980h) | Not reported | *Pimephales promelas* |
| 253 | Oliver and Niimi (1988) | Field samples. | Freshwater fish |
| Compound: Hexachlorobutadiene | | | Recommended BCF value: 783 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 920<br>1,200 | Leeuwangh, Bult, and Schneiders (1975) | 49-day exposure duration; 15-day depuration. The values reported in Leeuwangh, Bult, and Schneiders (1975) were converted to wet weight using an unit conversion factor of 5.0 [a]. | *Carassius auratus* |
| 435 | Laska, Bartell, Laseter (1976) | Not reported | *Gambusia affinis* |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF value: 165 |
| The recommended BCF value was calculated using the geometric mean of 6 laboratory values as follows: | | | |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 1,230 | Freitag, Geyer, Kraus, Viswanathan, Kotzias, Attar, Klein, and Korte (1982) | 3-day exposure duration | *Leuciscus idus* |
| 448 | Lu and Metcalf (1975) | Not reported. The values reported in Lu and Metcalf (1975) were converted to wet weight using an unit conversion factor of 5.0 [a] | *Gambusia affinis* |
| 100<br>1,148 | Podowski and Khan (1984) | 16-day exposure duration | *Carassius auratus* |
| 11 | Spehar, Veith, DeFoe, and Bergstedt (1979) | 30-day exposure duration | *Pimephales promelas* |
| 29 | Veith, DeFoe, and Bergstedt (1979) | 32-day exposure duration | *Pimephales promelas* |
| Compound: Pentachlorobenzene | | | Recommended BCF value: 12,690 |
| The recommended BCF value was calculated using the geometric mean of 12 laboratory values as follows: | | | |
| 5,100<br>7,100<br>7,300 | Banerjee, Suggatt, and O'Grady (1984) | 2-day exposure duration | *Lepomis macrochirus*<br>*Oncorynchus mykiss*<br>*Poecilia reticulata* |
| 26,000 | Bruggeman, Oppenhuizen, Wijbenga, and Hutzinger (1984) | Not reported | *Poecilia reticulata* |
| 8,400 | Carlson and Kosian (1987) | 31-day exposure duration | *Pimephales promelas* |
| 28,183 | Ikemoto, Motoba, Suzuki, Uchida (1992) | 24-hour exposure duration | *Oryzias latipes* |
| 260,000 | Konemann and van Leeuwen (1980) | Not reported | *Poecilia reticulata* |
| 17,000 | Opperhuizen, Velde, Gobas, Liem, and Steen (1985) | Multiple exposure durations | *Poecilia reticulata* |
| 6,600 | Qiao and Farrell (1996) | 10-day exposure duration | *Oncorhynchus mykiss* |
| 23,000 | Schrap and Opperhuizen (1990) | Not reported | *Poecilia reticulata* |
| 4,700 | Van Hoogen and Opperhuizen (1988) | 5-day exposure duration; 21-day depuration | *Poecilia reticulata* |
| 3,400 | Veith, Macek, Petrocelli, and Carroll (1980) | 28-day exposure duration | *Lepomis macrochirus* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Pentachlorophenol | | | Recommended BCF value: 109 |
| The recommended BCF value was calculated using the geometric mean of 20 laboratory values as follows: | | | |
| 128<br>776 | Garten and Trabalka (1983) | Not reported | Fish |
| 189.5 | Gates and Tjeerdema (1993) | 1-day exposure duration | *Morone saxatilis* |
| 2<br>131 | Kobayashi and Kishino (1980) | 1-hour exposure duration | *Carassius auratus* |
| 350 | Korte, Freitag, Geyer, Klein, Karus, and Lahaniatis (1978) | 1-day exposure duration | *Zeucisens idus melanotus* |
| 16<br>48<br>5<br>27 | Parrish, Dyar, Enos, and Wilson (1978) | 28 to 151-day exposure duration | *Cyprinodon variegatus* |
| 30<br>38 | Schimmel, Patrick, and Faas (1978) | 28-day exposure duration | *Funidulus similis*<br>*Mugil cephalus* |
| 216 | Smith, Bharath, Mallard, Orr, McCarty, and Ozburn (1990) | 28-day exposure; 14-day depuration | *Jordanella floridae* |
| 1,066<br>434<br>426<br>281 | Spehar , Nelson, Swanson, and Renoos (1985) | 32-day exposure duration | *Pimephales promelas* |
| 52.3<br>607 | Stehly and Hayton (1990) | 96-hour exposure | *Carassius auratus* |
| 770 | Veith, DeFoe, and Bergstedt (1979) | 32-day exposure | *Pimephales promelas* |
| **Pesticides** | | | |
| Compound: 4,4-DDE | | | Recommended BCF value: 25,512 |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| The recommended BCF value was calculated using the geometric mean of 11 laboratory values as follows: | | | |
| 12,037 | Metcalf, Sanborn, Lu, and Nye (1975) | Not reported | Fish |
| 51,285<br>27,542 | Garten and Trabalka (1983) | Freshwater | Fish |
| 5,010<br>110,000<br>106,000<br>181,000 | Hamelink and Waybrant (1976) | Not reported | *Lepomis macrochirus*<br>*Oncorhynchus mykiss* |
| 27,358 | Metcalf, Sangha, and Kapoor (1971) | 33-day exposure duration | *Gambusia affinis* |
| 217<br>27,358 | Metcalf, Kapoor, Lu, Schuth, and Sherman (1973) | 3 to 33-day exposure duration | *Gambusia affinis* |
| 81,000 | Oliver and Niimi (1985) | 96-day exposure duration | *Oncorhynchus mykiss* |
| 51,000 | Veith, DeFoe, and Bergstedt (1979) | 32-day exposure duration | *Pimephales promelas* |
| Compound: Heptachlor | | | Recommended BCF value: 5,522 |
| The recommended BCF value was calculated using the geometric mean of 7 laboratory values as follows: | | | |
| 3,700<br>2,400<br>4,600 | Goodman, Hansen, Couch, and Forester (1978) | 28-day exposure duration | *Cyprinodon variegatus* |
| 3,600<br>10,000 | Schimmel, Patrick, and Forester (1976) | 96-hour exposure duration | *Leiostomus xanthurus* |
| 11,200 | U.S. EPA (1980a) | Not reported | Fish |
| 9,500 | Veith, DeFoe, and Bergstedt (1979) | 32-day exposure duration | *Pimephales promelas* |
| Compound: Hexachlorophene | | | Recommended BCF value: 278 |
| The recommended BCF value was based on data from one study as follows: | | | |
| 278 | Sanborn (1974) | Not reported | *Oncorhychus mykiss* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)

**(Page 13 of 19)**

| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF value: 2.70 |
| The recommended BCF value was calculated using the geometric mean of 7 laboratory values as follows: | | | |
| 0.05<br>1.25<br>0.05<br>0.35 | Cleveland, Little, Hamilton, Buckler, and Hunn (1986) | 37-day exposure duration | *Salvelinus fontinalis* |
| 36<br>123<br>215 | Cleveland, Buckler, and Brumbaugh (1991) | 56-day exposure duration; 28-day depuration | *Salvelinus fontinalis* |
| Compound: Antimony | | | Recommended BCF value: 40 |
| The recommended BCF value was based on one study as follows: | | | |
| 40 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| Compound: Arsenic | | | Recommended BCF value: 114 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 333<br>100 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| 44 | U.S. EPA (1992b) | Not reported | Fish |
| Compound: Barium | | | Recommended BCF value: 633 |
| Empirical data for this compound were not available. The recommended BCF is the arithmetic mean of the recommended values for 14 inorganics with empirical data available (aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc). | | | |
| Compound: Beryllium | | | Recommended BCF value: 62 |
| The recommended BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 200<br>200 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| 19 | U.S. EPA (1992b) | Not reported | Fish |
| 19 | U.S. EPA (1978) | 28-day exposure duration | Fish |
| Compound: Cadmium | | | Recommended BCF value: 907 |
| The recommended BCF value was calculated using the geometric mean of 4 field values. | | | |
| 558<br>1,295<br>729<br>1,286 | Saiki, Castleberry, May, Martin, and Ballard (1995) | Field samples. The field values reported in Saiki, Castleberry, May, Martin, and Ballard (1995) were converted to wet weight using a conversion factor of 5.0[a]. The field values are also based on mean values calculated for each of the 4 fish species. | *Catostomus occidentalis*<br>*Gasterosteus aculeatus*<br>*Ptychocheilus grandis*<br>*Oncorhynchus tshawytasch* |
| 716 | Benoit, Leonard, Christensen, and Fiandt (1976) | 38-week exposure duration; based on mean values calculated from various tissue concentrations in the kidney, liver, spleen, gonad, gills, and muscle/red blood cells. A unit conversion of 1,000 was applied to the value. | *Salvelinus fontanilis* |
| 480 | Eisler, Zaroogian, and Hennekey (1972) | 3-week exposure duration | *Fundulus heteroclitus* |
| 161<br>51 | Harrison and Klaverkamp (1989) | 72-day exposure duration, 25 and 63-day depuration | *Oncorhynchus mykiss*<br>*Coregonus clupeatormis* |
| 33 | Kumada, Kimura, and Yokote (1980) | 10 week exposure duration | *Oncorhynchus mykiss* |
| 8<br>3,333 | Kumada, Kimura, Yokote, and Matida (1973) | 280-day exposure; values are based on a high to low range of values. The values reported in Kumada, Kimura, Yokote, and Matida (1973) were converted to wet weight using a conversion factor of 5.0[a]. | *Oncorhynchus mykiss* |
| 4.4 | Spehar (1976) | 30-day exposure duration | *Jordanella floridae* |
| 3,000<br>200 | Thompson, Burton, Quinn and Ng (1972) | Not reported | Fish |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)

**(Page 15 of 19)**

| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 4,100 | Williams and Giesy (1979) | 56-day exposure duration | Fish |
| Compound: Chromium (total) | | | Recommended BCF value: 19 |
| The recommended BCF value was calculated using the geometric mean of 4 laboratory values as follows: | | | |
| 1.27<br>1.34 | Fromm and Stokes (1962) | 30-day exposure duration; values are based on a high to low range of reported values. | *Oncorhynchus mykiss* |
| 200<br>400 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| Compound: Copper | | | Recommended BCF value: 710 |
| The recommended BCF value was calculated using the geometric mean of 4 field values as follows: | | | |
| 761<br>697<br>1,236<br>387 | Saiki, Castleberry, May, Martin, and Ballard (1995) | Field samples | *Catostomus occidentalis*<br>*Gasterosteus aculeatus*<br>*Ptychocheilus grandis*<br>*Oncorhynchus tshawytasch* |
| 50<br>500<br>667 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| 36 | U.S. EPA (1992b) | Not reported | Fish |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)

**(Page 16 of 19)**

| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Cyanide (total) | | | Recommended BCF value: 633 |
| Empirical data for this compound were not available. The recommended BCF is the arithmetic mean of the recommended values for 14 inorganics with empirical data available (aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc). | | | |
| Compound: Lead | | | Recommended BCF value: 0.09 |
| The recommended BCF value based on one field value: | | | |
| 0.09 | Atchinson, Murphy, Bishop, McIntosh, and Mayes (1977) | Field samples. The values reported in Atchinson, Murphy, Bishop, McIntosh, and Mayes (1977) were converted to wet weight using a conversion factor of 5.0[a]. | *Lepomis macrochiras* |
| 0.15<br>0.17 | Holcombe, Benoit, Leonard, and McKim (1976) | 266-day exposure duration. The values reported in Holcombe, Benoit, Leonard, and McKim (1976) were converted to wet weight using a conversion factor of 5.0[a]. Mean values were calculated based on tissue concentrations in the red blood cells, kidney, and muscle. | *Salvelinus fontanilis* |
| 300<br>100 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| Compound: Mercuric chloride | | | Recommended BCF value: 3,530 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 1,800 | Boudou and Ribeyre (1984) | 60-day exposure duration | *Oncorhynchus mykiss* |
| 4,380<br>5,580 | Snarski and Olson (1982) | 287-day exposure duration; values are based on a high to low range of reported values. | *Pimephales promelas* |
| Compound: Methyl mercury | | | Recommended BCF value: 11,168 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 11,000 | Boudou and Ribeyre (1984) | 60-day exposure duration | *Oncorhynchus mykiss* |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 10,800<br>11,724 | McKim, Olson, Holcome, and Hunt (1976) | 756-day exposure duration | *Salvelinus fontinalis* |
| Compound: Nickel | | | Recommended BCF value: 78 |
| The recommended BCF value was calculated using the geometric mean of 3 laboratory values as follows: | | | |
| 100<br>100 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| 47 | U.S. EPA (1992b) | Not reported | Fish |
| Compound: Selenium | | | Recommended BCF value: 129 |
| The recommended BCF value was calculated using the geometric mean of 12 laboratory values as follows: | | | |
| 18 | Adams (1976) | 96-day exposure duration | Fish |
| 4,900 | Besser, Canfield, and LaPoint (1993) | 30-day exposure duration | *Lepomis reinhardtii* |
| 5<br>7 | Cleveland , Little, Buckler, and Wiedmeyer (1993) | 60-day exposure duration; values are based on a high to low range of reported values. | *Lepomis macrochirus* |
| 154<br>711 | Dobbs, Cherry, and Cairns (1996) | 25-day exposure duration | *Pimephales promelas* |
| 3<br>240 | Hodson, Spry, and Blunt (1980) | 351-day exposure duration; values represent a high to low range of reported values based on BCFs for peritoneal fat and the liver. | *Oncorhynchus mykiss* |
| 285<br>465 | Lemly (1982) | 120-day exposure duration | *Micropterus salmoides*<br>*Lepomis macrochirus* |
| 4,000<br>167 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| Compound: Silver | | | Recommended BCF value: 87.71 |
| The recommended BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 3,330 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



| Reported Values | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Thallium | | | Recommended BCF value: 10,000 |
| The recommended BCF value was calculated using the geometric mean of 2 laboratory values as follows: | | | |
| 10,000<br>10,000 | Thompson, Burton, Quinn, and Ng (1972) | Not reported | Fish |
| Compound: Zinc | | | Recommended BCF value: 2,059 |
| The recommended BCF value was calculated using the geometric mean of 4 field values as follows: | | | |
| 2,299<br>2,265<br>4,290<br>804 | Saiki, Castleberry, May, Martin, and Ballard (1995) | Field samples. | *Catostomus occidentalis*<br>*Gasteroteus aculeatus*<br>*Ptychocheilus grandis*<br>*Oncorhynchus tshawytasch* |
| 50<br>130<br>130<br>200 | Deutch, Borg, Kloster, Meyer, and Moller (1980) | 9-day exposure duration | *Spinachia vulgaris*<br>*Gasterosteus acul.*<br>*Pungitius pungitius*<br>*Cottus scorpius* |
| 373<br>8,853 | Pentreath (1973) | 180-day exposure duration; values are based on a high to low range of reported values | *Pleuronectes platessa* |
| 1,000<br>2,000<br>2,000 | Thompson, Burton, Quinn and Ng (1972) | Not reported | Fish |
| 47 | U.S. EPA (1992b) | Not reported | Fish |

Notes:

(a) The reported values are presented as the amount of COPC in fish tissue divided by the amount of COPC in water. If the values reported in the studies were presented as dry tissue weight, they were converted to wet weight by dividing the concentration in dry fish tissue weight by 5.0. This conversion factor assumes a fish's total weight is 80.0 percent moisture (Holcomb, Benoit, Leonard, and McKim 1976).

## TABLE C-5

## WATER-TO-FISH BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg dissolved COPC / L water)



The conversion factor was calculated as follows:

$$Conversion\ factor = \frac{1.0\ g\ fish\ total\ weight}{1.0\ g\ fish\ total\ weight\ -\ 0.80\ g\ fish\ wet\ weight}$$

(b) The equation used to convert the total organic COPC concentrations in field samples to dissolved COPC concentrations is from U.S. EPA (1995a) as follows:

$BAF\ (dissolved) = (BAF\ (total) / f_{fd}) - 1$

where: *BAF (dissolved)* = *BAF* based on dissolved concentration of COPC in water
*BAF (total)* = *BAF* based on the field derived data for total concentration of COPC in water
$f_{fd}$ = Fraction of COPC that is freely dissolved in the water
where: $f_{fd} = 1 / [1 + ((DOC \times K_{ow}) / 10) + (POC \times K_{ow})]$
$DOC$ = Dissolved organic carbon, Kg of organic carbon / L of water ($2.0 \times 10^{-06}$ kg/L)
$K_{ow}$ = Octanol-water partition coefficient of the COPC, as reported in U.S. EPA (1994b)
$POC$ = Particulate organic carbon, Kg of organic carbon / L of water ($7.5 \times 10^{-09}$ Kg/L)

(c) The reported field *BAF*s were converted to *BCF*s as follows:

$BCF = (BAF_{TLn} / FCM_{TLn}) - 1$

where: $BAF_{TLn}$ = The reported field bioaccumulation factor for the trophic level "n" of the study species.
$FCM_{TLn}$ = The food chain multiplier for the trophic level "n" of the study species.

(d) PCB values were converted to dissolved COPC BCFs based on the $K_{ow}$ for Aroclor 1254.

(e) The geometric mean of the converted field derived BCFs was compared to the geometric mean of the laboratory derived BCFs. The higher of the two values was selected as the COPC BCF.

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Dioxins and Furans** | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) | | | Recommended BCF value: 19,596 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 6.64 (U.S. EPA 1994a) | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzo(p)dioxin (1,2,3,7,8-PeCDD) | | | Recommended BCF value: 18,023 |
| The BCF was calculated using the TCDD BCF and a congener-speccific bioaccumulation equivalency factor (BEF) (U.S. EPA 1995b) as follows: BCF =19,596 x 0.92 =3,896 | | | |
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-HxCDD) | | | Recommended BCF value: 6,075 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.31 =1313 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-HxCDD) | | | Recommended BCF value: 2,351 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.12 =2,351 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-HxCDD) | | | Recommended BCF value: 2,743 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.14 =2,743 | | | |
| Compound: 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD) | | | Recommended BCF value: 99.4 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.051 =99.4 | | | |
| Compound: Octachlorodibenzo-p-dioxin (OCDD) | | | Recommended BCF value: 23.5 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.012 =23.5 | | | |
| Compound: 2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF) | | | Recommended BCF value: 2,642 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF = 3,302 x0.80 = 2,642 | | | |
| Compound: 1,2,3,7,8-Pentachlorodibenzo-p-furan (1,2,3,7,8-PeCDF) | | | Recommended BCF value: 4,311 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.22 =4,311 | | | |
| Compound: 2,3,4,7,8-Pentachlorodibenzo-p-furan (2,3,4,7,8-PeCDF) | | | Recommended BCF value: 31,354 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 1.6 =31,354 | | | |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: 1,2,3,4,7,8-Hexachlorodibenzo-p-furan (1,2,3,4,7,8-HxCDF) | | | Recommended BCF value: 1,489 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.076 =1,489 | | | |
| Compound: 1,2,3,6,7,8-Hexachlorodibenzo-p-furan (1,2,3,6,7,8-HxCDF) | | | Recommended BCF value: 3,723 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.19 =3,723 | | | |
| Compound: 2,3,4,6,7,8-Hexachlorodibenzo-p-furan (2,3,4,6,7,8-HxCDF) | | | Recommended BCF value: 13,129 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.67 = 13,129 | | | |
| Compound: 1,2,3,7,8,9-Hexachlorodibenzo-p-furan (1,2,3,7,8,9-HxCDF) | | | Recommended BCF value: 12,345 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.63 =12,345 | | | |
| Compound: 1,2,3,4,6,7,8,-Heptachlorodibenzo-p-furan (1,2,3,4,6,7,8-HpCDF) | | | Recommended BCF value: 215.6 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.011 =215.6 | | | |
| Compound: 1,2,3,4,7,8,9-Heptachlorodibenzo-p-furan (1,2,3,4,7,8,9-HpCDF) | | | Recommended BCF value: 7,642 |
| The BCF was calculated using the TCDD BCF and a congener-specific (U.S. EPA 1995b) as follows: BCF =19,596 x 0.39 =7,642 | | | |
| Compound: Octachlorodibenzo-p-furan (OCDF) | | | Recommended BCF value: 313.5 |
| The BCF was calculated using the TCDD BCF and a congener-specific BEF (U.S. EPA 1995b) as follows: BCF =19,596 x 0.016 =313.5 | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | |
| Compound: Benzo(a)pyrene | | | Recommended BCF value: 1. 59 |
| The recommended BCF value was calculated using the geometric mean of 8 values as follows: | | | |
| 5.2<br>2.8 | Augenfeld, Anderson, Riley, and Thomas (1982) | 60-day exposure duration | *Macoma inquinata*<br>*Abarenicola pacifica* |
| 0.4<br>0.65<br>7.4 | Driscoll and McElroy (1996) | 6 to 12-day exposure duration | *Nereis diversicolor*<br>*Scolecolipides virdis*<br>*Leitoscoloplos fragilis* |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 2.3<br>6.9 | Landrum, Eadie, and Faust (1991) | Mixture of PAH at four concentrations | *Diporeia* sp. |
| 0.09 | Roesijadi, Anderson, and Blaylock (1978) | 7-day exposure duration | *Macoma inquinata* |
| Compound: Benzo(a)anthracene | | | Recommended BCF value: 1.45 |
| Empirical data for this compound were not available. Therefore, the BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(b)fluoranthene | | | Recommended BCF value: 1.61 |
| Empirical data for this compound were not available. Therefore, the BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Benzo(k)fluoranthene | | | Recommended BCF value: 1.61 |
| Empirical data for this compound were not available. Therefore, the BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Chrysene | | | Recommended BCF value: 1.38 |
| BCF value was calculated using the geometric mean of 3 values as follows: | | | |
| 0.04 | Roesijadi, Anderson, and Blaylock (1978) | 7-day exposure duration | *Macoma inquinata* |
| 11.6<br>5.64 | Augenfeld, Anderson, Riley, and Thomas (1982) | 60-day exposure duration | *Macoma inquinata*<br>*Abarenicola pacifica* |
| Compound: Dibenz(a,h)anthracene | | | Recommended BCF value: 1.61 |
| Empirical data for this compound were not available. Therefore, the BCF for benzo(a)pyrene was used as a surrogate. | | | |
| Compound: Indeno(1,2,3-cd)pyrene | | | Recommended BCF value: 1.61 |
| Empirical data for this compound were not available. Therefore, the BCF for benzo(a)pyrene was used as a surrogate. | | | |
| **Polychlorinated Biphenyls (PCBs)** | | | |
| Compound: Aroclor 1016 | | | Recommended BCF value: 0.53 |
| The recommended BCF value was calculated using the geometric mean of 2 empirical values as follows: | | | |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| 0.2<br>1.4 | Wood, O'Keefe, and Bush (1997) | 12-day exposure duration; 1-day depuration | *Chironomus tentans* |
| Compound: Aroclor 1254 | | | Recommended BCF value: 0.53 |
| The recommended BCF value was calculated using the geometric mean of 2 empirical values as follows: | | | |
| 0.2<br>1.4 | Wood, O'Keefe, and Bush (1997) | 12-day exposure duration; 1-day depuration | *Chironomus tentans* |
| **Nitroaromatics** | | | |
| Compound: 1,3-Dinitrobenzene | | | Recommended BCF value: 1.19 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.491 (U.S. EPA 1994b) | | | |
| Compound: 2,4-Dinitrotoluene | | | Recommended BCF value: 58 |
| The recommended BCF value was based on 1 study as follows: | | | |
| 58 | Liu, Bailey, and Pearson (1983) | 4-day exposure duration | *Lumbriculus variegatus* |
| Compound: 2,6-Dinitrotoluene | | | Recommended BCF value: 2.50 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.886 (U.S. EPA 1994b) | | | |
| Compound: Nitrobenzene | | | Recommended BCF value: 2.27 |
| Empirical data were not available for this compound. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.833 (U.S. EPA 1994b) | | | |
| Compound: Pentachloronitrobenzene | | | Recommended BCF value: 451 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 4.640 (U.S. EPA 1994b) | | | |
| **Phthalate Esters** | | | |
| Compound: Bis(2-ethylhexyl)phthalate | | | Recommended BCF value: 1,309 |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 5.205 (U.S. EPA 1994b) | | | |
| Compound: Di(n)octyl phthalate | | | Recommended BCF value: 3,128,023 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 9.330 (U.S. EPA 1994b) | | | |
| **Volatile Organic Compounds** | | | |
| Compound: Acetone | | | Recommended BCF value: 0.05 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.222 (Karickoff and Long 1995) | | | |
| Compound: Acrylonitrile | | | Recommended BCF value: 0.11 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.250 (Karickoff and Long 1995) | | | |
| Compound: Chloroform | | | Recommended BCF value: 2.82 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.949 (U.S. EPA 1994b) | | | |
| Compound: Crotonaldehyde | | | Recommended BCF value: 0.20 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.55 (based on equations developed by Hansch and Leo 1979, as calculated in NRC 1981) | | | |
| Compound: 1,4-Dioxane | | | Recommended BCF value: 0.04 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = -0.268 (U.S. EPA 1995a) | | | |
| Compound: Formaldehyde | | | Recommended BCF value: 0.14 |
| Empirical data for this compound were not available.The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 0.342 (U.S. EPA 1995a) | | | |
| Compound: Vinyl chloride | | | Recommended BCF value: 0.62 |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 1.146 (U.S. EPA 1994b) | | | |
| **Other Chlorinated Organics** | | | |
| Compound: Carbon tetrachloride | | | Recommended BCF value: 12 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 2.717 (U.S. EPA 1994b) | | | |
| Compound: Hexachlorobenzene | | | Recommended BCF value: 2,296 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 5.503 (U.S. EPA 1994b) | | | |
| Compound: Hexachlorobutadiene | | | Recommended BCF value: 0.44 |
| The recommended BCF value was based on empirical data from one study as follows: | | | |
| 0.44 | Oliver (1987) | 79-day exposure duration; The values reported in Oliver (1987) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | Oligochaetes |
| Compound: Hexachlorocyclopentadiene | | | Recommended BCF value: 746 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 4.907 (U.S. EPA 1994b) | | | |
| Compound: Pentachlorobenzene | | | Recommended BCF value: 0.32 |
| The recommended BCF value is based on 1 study as follows: | | | |
| 0.32 | Oliver (1987) | 79-day exposure duration; The values reported in Oliver (1987) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | Oligochaetes |
| Compound: Pentachlorophenol | | | Recommended BCF value: 1,034 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation: log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 5.080 (U.S. EPA 1994b) | | | |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| **Pesticides** | | | |
| Compound: 4,4'-DDE | | | Recommended BCF value: 0.95 |
| The recommended BCF value was calculated using the geometric mean of 13 values as follows: | | | |
| 2.9<br>1.3<br>0.4<br>0.2<br>2.2<br>0.1<br>1.2<br>9.6<br>2.1<br>24.6<br>1.8<br>0.1<br>0.07 | Reich, Perkins, and Cutter (1986) | Field samples | Tubificidae<br>Chironomidae<br>Croixidae |
| Compound: Heptachlor | | | Recommended BCF value: 1.67 |
| Empirical data for heptachlor were not available. The BCF was calculated from 1 field-derived value for heptachlor epoxide as follows: | | | |
| 10.0 | Beyer and Gish (1980) | Field samples; The value reported in Beyer and Gish (1980) was converted to wet weight over dry weight using a conversion factor of 5.99[a]. | *Aporrectodea trapezoides*<br>*Aparrectodea turgida*<br>*Allolobophora chlorotica*<br>*Lumbricus terrestris* |
| Compound: Hexachlorophene | | | Recommended BCF value: 106,970 |
| Empirical data for this compound were not available. The BCF was calculated using the following regression equation:<br>log BCF = 0.819 x log $K_{ow}$ - 1.146 (Southworth, Beauchamp, and Schmieder 1978), where log $K_{ow}$ = 7.540 (Karickoff and Long 1995) | | | |
| **Inorganics** | | | |
| Compound: Aluminum | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |
| Compound: Antimony | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| Compound: Arsenic | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |
| Compound: Barium | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |
| Compound: Beryllium | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |
| Compound: Cadmium | | | Recommended BCF value: 3.4 |
| The recommended BCF value was calculated using the geometric mean of 8 field-derived values as follows: | | | |
| 3.33 7.68<br>1.79 7.15<br>1.67 2.34<br>2.27 6.29 | Saiki, Castleberry, May, Martin, and Bullard (1995) | Field samples; The values reported in Saiki, Castleberry, May, Martin, and Bullard (1995) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | Chironomidae<br>Epheroptera |
| Compound: Chromium (total) | | | Recommended BCF value: 0.39 |
| The recommended BCF value was based on 1 field-derived value as follows: | | | |
| 0.39 | Namminga and Wilhm (1977) | Field samples | Chironomidae |
| 0.03 0.07<br>0.001 0.003 | Capuzzo and Sasner (1977) | 168-day exposure duration; The reported value was calculated by dividing the tissue concentration by the media concentration [(µg/g)/(mg/g)] and a conversion factor of $1x10^{-3}$ was applied to the value. A conversion factor of 5.99[a] was applied to convert dry tissue weight to wet weight. | *Mya arenaria* |
| Compound: Copper | | | Recommended BCF value: 0.30 |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | Reference | Experimental Parameters | Species |
|---|---|---|---|
| The recommended BCF value was calculated using the geometric mean of 9 field values as follows: | | | |
| 0.11<br>0.22<br>0.13<br>0.32 | Jones, Jones, and Radlett (1976) | 25-day exposure duration; The values reported in Jones, Jones, and Radlett (1976) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | *Nereis diveriscolor* |
| 1.1 | Namminga and Wilhm (1977) | Field samples | Chironomidae |
| 0.29<br>0.36<br>0.16<br>0.73<br>0.31<br>0.36<br>0.06<br>0.25 | Saiki, Castleberry, May, Martin and Bullard (1995) | Field samples; The values reported in Saiki, Castleberry, May, Martin and Bullard (1995) were converted to wet weight over dry weight using a conversion factor of 5.99[a]. | Chironomidae<br>Ephemeroptera |
| Compound: Cyanide (total) | | | Recommended BCF value: 0.90 |
| Empirical data were not available for this compound. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | |
| Compound: Lead | | | Recommended BCF value: 0.63 |
| The recommended BCF value was based on 1 study follows: | | | |
| 0.4<br>1.0 | Harrahy and Clements (1997) | 14-day exposure duration | *Chironomus tentans* |
| Compound: Mercuric chloride | | | Recommended BCF value: 0.068 |
| The recommended BCF value was based on 6 field values as follows: | | | |
| 0.08 | Saouter, Hare, Campbell, Boudou, and Ribeyre (1993) | 9-day exposure duration | *Hexagenia rigida* |
| 0.16<br>0.08<br>0.04<br>0.04<br>0.08<br>0.06 | Hildebrand, Strand, and Huckabee (1980) | Field samples | Hydropsychidae, Corydalus, Decapoda, Aterix, Psephenidae, and unspecified other benthic invertebrates |
| Compound: Methyl mercury | | | Recommended BCF value: 0.48 |
| The recommended BCF value was based on 6 field values as follows: | | | |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



| Reported Values[a] | | Reference | Experimental Parameters | Species |
|---|---|---|---|---|
| 4.0 | | Saouter, Hare, Campbell, Boudou, and Ribeyre (1993) | 9-day exposure duration | *Hexagenia rigida* |
| 1.45<br>0.50<br>0.26 | 0.41<br>0.37<br>0.44 | Hildebrand, Strand, and Huckabee (1980) | Field samples | Hydropsychidae, Corydalus, Decapoda, Aterix, Psephenidae, and unspecified other benthic invertebrates |
| Compound: Nickel | | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | | |
| Compound: Selenium | | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | | |
| Compound: Silver | | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | | |
| Compound: Thallium | | | | Recommended BCF value: 0.90 |
| Empirical data for this compound were not available. The recommended BCF value is the arithmetic average of 6 recommended values for those metals with empirical data (cadmium, chromium, copper, lead, inorganic mercury, and zinc). | | | | |
| Compound: Zinc | | | | Recommended BCF value: 0.57 |
| The recommended BCF value was calculated using the geometric mean of 8 field values as follows: | | | | |
| 3.6 | | Namminga and Wilhm (1977) | Not reported | Chironomidae |
| 0.46<br>0.38<br>0.13<br>0.79 | 0.83<br>1.16<br>0.39<br>1.57 | Saiki, Castleberry, May, Martin, and Bullard (1995) | Field samples; the values reported in Saiki, Castleberry, May, Martin and Bullard (1995) were converted to wet weight over dry weight using an unit conversion factor of 5.99[a]. | Chironomidae<br>Ephemeroptera |

## TABLE C-6

## SEDIMENT-TO-BENTHIC INVERTEBRATE BIOCONCENTRATION FACTORS
## (mg COPC / kg wet tissue) / (mg COPC / kg dry sediment)



Notes:

(a) The reported values are presented as the amount of compound in invertebrate tissue divided by the amount of compound in the sediment. If the values reported in the studies were presented as dry tissue weight over dry sediment weight, they were converted to wet weight over dry weight by dividing the concentration in dry invertebrate tissue weight by 5.99. This conversion factor assumes an earthworm's total weight is 83.3 percent moisture (Pietz et al. 1984).

The conversion factor was calculated as follows:

$$Conversion\ factor = \frac{1.0\ g\ invertebrate\ total\ weight}{1.0\ g\ invertebrate\ total\ weight\ -\ 0.833\ g\ invertebrate\ wet\ weight}$$

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