ERRATA FOR HUMAN HEALTH RISK ASSESSMENT, GE/HOUSATONIC RIVER SITE, REST OF RIVER (FEBRUARY 2005)

DCN GE-120205-ACZH

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The following is a brief discussion of changes to Section 10.3 and associated tables and figures. These corrections are the result of milk fat ($C_{milk\ fat}$) recalculations because of a spreadsheet error in the risk assessment for fish, waterfowl, and dairy. The effect of these corrections is to increase the predicted $C_{milk\ fat}$ concentrations reported in the February 2005 HHRA by a factor of 11. Where applicable, the corrected text has been provided below.

1. Page 10-16, Equation 1: The conversion factor of ($1x10^3$) was removed from the equation. The units for the $C_{milk\ fat}$ term were corrected from **ng** contaminant/**g** milk fat to **mg** contaminant/**kg** milk fat. The conversion factor was not used in the calculations, and this change does not affect the reported results.

2. Page 10-17, line 17: The units for ingestion rate have been corrected from (mg tissue/d) to (g tissue/d). The correct units were used in calculations, and this change does not affect the reported results.

3. Page 10-27, line 28: The sentence describing the table organization for Tables 10-16 to 10-21 was corrected. The correct sentence is listed below.

Each of these tables is organized similarly, with each row listing the congener, the EPC used in the calculation, the predicted congener concentrations in milk fat, the mean expected background concentration, and the ratio of the predicted incremental concentration in breast milk with anticipated background.

4. Page 10-28: The following sentence was removed to reflect the numerical changes in the results.

The columns colored black at the top indicate that the predicted concentration/background concentration is less than 1, indicating that only modest increases in breast milk concentrations (less than a doubling of background), would be expected from the additional exposure.

5. Page 10-28, first complete paragraph: The text description of the results was changed to reflect the numerical changes in the results. The corrected paragraph is below.

The analysis indicates that both high-end and central tendency patterns of fish and waterfowl consumption from the PSA and consumption of dairy products raised in the backyard farmer scenario (with 2 mg/kg tPCBs in soil) will result in elevated concentrations of tPCBs in breast milk. Of the abundant PCB congeners, those which account for 30 to 50% of the tPCB concentration, PCB-138, PCB-153, and PCB-180, will be substantially (80 to 140 times) elevated following RME fish consumption patterns and less, but still substantially, elevated (19 to 25 times) following RME waterfowl consumption. The predictions for the abundant congeners are consistent with the predictions based on tPCB concentrations.

6. Page 10-28, second paragraph: The text description of the results was changed to reflect the numerical changes in the results. The corrected text description is below.

A somewhat different pattern is evident for TEQ. As shown in Figure 10-3, high-end consumption patterns of fish and waterfowl result in additional concentrations of TEQ approximately 40 times higher than background. The ratio of TEQ to background is higher than the ratio of tPCBs to background for waterfowl and dairy, but lower for fish. For the dioxin-like congeners, the greatest increase in concentration over background is predicted for PCB-126, the dioxin-like congener with the highest TEF, for fish and waterfowl; for dairy, PCB-169 is predicted to have the largest increase over background. The ratio of the predicted/background TEQ for dairy consumption shown in Figure 10-3 is based on an assumed soil PCB concentration of 2 mg/kg and the ratio would be proportionately higher for soil PCB concentrations greater than 2 mg/kg.

7. Page 10-29, first complete paragraph: The text description of the results was changed to reflect the numerical changes in the results. The corrected text description is below.

Concentrations of PCBs in breast milk resulting from direct contact exposure to soil and sediment can be predicted by comparing the ADD for tPCB for the consumption scenarios with those from direct contact. The central tendency ADD for the backyard dairy scenario, based on example calculations assuming 2 ppm PCBs in soil, is 7E-05 mg/kg-d (Table 10-21). By comparison, one of the highest (direct contact) risks is associated with angling in EA 59A, where the RME ADD for an adult angler is 2E-05 mg/kg-d, or 3.5 times lower. For the CTE backyard dairy scenario, the predicted PCB concentration due to consuming milk from cows raised on soil with a concentration of 2 ppm PCBs is 2 times the anticipated background concentration. Thus, the highest expected added tPCB concentration in breast milk for a high-end direct contact scenario is 2 divided by 3.5, or less than the anticipated background. Consistent with the observation in New Bedford (Korrick and Altschul, 1998), no elevation in breast milk concentrations of PCBs is anticipated as a result of direct contact exposure to soil and sediment.

8. Page 10-29, third paragraph: The text description was changed to reflect the numerical changes in the results.

The half-life of elimination of PCBs from the body selected for all of the calculations was a central tendency estimate of 6 years.

9. Tables 10-16 through 10-21 were corrected to reflect the numerical changes in the results.

10. Figures 10-3 through 10-5 were corrected to reflect the numerical changes in the results.

The general equation for estimating chemical concentrations in breast milk fat (EPA, 1998a) is:

$$C_{\text{milk fat}} = \frac{ADD \times h \times f_1}{0.693 \times f_2} \qquad \text{(Equation 1)}$$

where:

Term	Definition	Units	Reference
$C_{\text{milk fat}}$	Concentration of contaminant in milk fat	mg contaminant/kg milk fat	Calculated, exposure scenario specific
ADD	Average maternal intake of contaminant for adult exposure scenario	mg contaminant/kg body weight-day	Eq. 2, exposure scenario specific
h	Half-life of contaminant in adults	days	Sec. 10.3.1.2 and Table 10-14
f_1	Fraction of ingested contaminant that is stored in fat		0.9 (Poiger and Schlatter, 1986)
f_2	Fraction of mother's weight that is fat		0.3 (Sullivan et al., 1991)

Maternal intake, or ADD, is based on the exposure scenarios evaluated in the fish and waterfowl, and agricultural products components of this risk assessment, and further described in Section 10.3.1.1. The half-lives of PCB congeners were obtained through a review of the scientific literature. The values for f_1 and f_2 are those suggested in EPA guidance documents (EPA, 1998a, b).

10.3.1.1 Maternal Intake

The maternal intakes of selected PCB congeners were used to estimate the breast milk concentration as a result of exposure via the following scenarios:

- Consumption of fish.
- Consumption of waterfowl.
- Consumption of agricultural products (milk from backyard farms).

Women can also be exposed to PCBs via direct contact with soil and sediment, as described in Section 7 and in more detail in Appendix B, Volume IIIA. However, the resulting exposures are substantially lower than those predicted for fish, waterfowl, and milk consumption. As discussed in Section 10.3.3, these exposures are not likely to contribute substantially to breast milk concentrations of PCBs.

The equation for calculating average daily maternal intake for food consumption scenarios is the same as the equation used to estimate adult intake of contaminants for noncancer hazards for these exposure pathways (described in Sections 8 and 9 as well as Volumes IV and V of this report).

$$\text{ADD (mg/kg-d)} = \frac{\text{EPC x (1 - LOSS) x IR x EF x FI x ED x CF}}{\text{BW x AT}} \quad \text{(Equation 2)}$$

where:

ADD	=	Average daily dose for each congener (mg congener/kg body weight-d)
EPC	=	Concentration of each congener in matrix consumed (mg congener/kg matrix)
LOSS	=	Fraction of congener lost during cooking (unitless)
IR	=	Ingestion rate (g tissue/d)
EF	=	Exposure frequency, 365 days/year when IR is an annual average (fish, waterfowl)
FI	=	Fraction of fish, waterfowl, or agriculture product ingested from the site
ED	=	Exposure duration; this is equal to the AT, averaging time, so these parameters cancel each other out
CF	=	Conversion factor, 0.001 kg/g
BW	=	Body weight of the female (kg)

The RME and CTE exposure parameters used in the maternal intake (ADD) calculation are summarized in Table 10-11.

The concentration terms are based on the 95% upper confidence limit (UCL) of the mean as typically used as an EPC. However, in contrast to the methodology used elsewhere in this risk assessment, all UCLs were calculated using Hall's Bootstrap methodology (Attachment 4). Tables 10-12 and 10-13 present the mean, 95th UCL of the mean, and 95th percentile of the based on only 3 individuals, rather than the 122 individuals in the New Bedford study. The Canadian data may also be a good basis for the breast milk comparison based on similarities of food supply. Although the Canadian data were collected in 1992, and may overestimate current breast milk concentrations by as much as a factor of 2, they are generally lower than the Massachusetts and New York data. Thus, the use of the Canadian values as the basis for comparison would indicate greater increases in breast milk concentrations of PCBs due to consumption of fish, waterfowl, and agricultural products from the HRA.

Neither the New Bedford (Korrick and Altschul, 1998) nor the New York State (Greizerstein et al., 1999) data set reports concentrations for PCB-126 and PCB-169. The Swedish data (Noren and Meironyte, 2000) from 1997 are used to represent background for these congeners. These data, like the New Bedford data, represent a mean of many women, and the samples were collected during the same time frame. For all three data sets, the tPCB concentrations are similar, as are the concentrations of most of the individual congeners. The Swedish data for PCB-126 and PCB-169 are preferred to the data from Belgium (Focant et al., 2002) because the Belgian data were obtained from a highly industrialized area that is not representative of conditions in the HRA. Use of the MAFF data from the UK, although from a somewhat earlier time-period, may also have been reasonable. Use of the UK data would have predicted 2 to 4 times greater increases in milk concentrations of PCB-126 and PCB-169.

10.3.3 Comparison of Predicted Breast Milk Concentrations with Anticipated Background Concentrations

Tables 10-16 through 10-21 summarize the calculations of predicted incremental, or additional, concentrations of tPCBs and specific PCB congeners in human breast milk due to maternal exposures to fish and waterfowl in the PSA, and consumption of dairy products from cows raised in the backyard farming scenario (based on an example PCB soil contamination concentration of 2 mg/kg). These predictions are compared to anticipated background concentrations that HRA residents would likely receive from other sources. Tables 10-16, 10-18, and 10-20 provide the comparisons based on RME exposures and Tables 10-17, 10-19, and 10-21 provide the same comparison based on CTE exposures. Each of these tables is organized similarly, with each row listing the congener, the EPC used in the calculation, the predicted congener concentrations in milk fat, the mean expected background concentration, and the ratio of the predicted incremental concentration in breast milk with anticipated background. The results are also summarized in graphical form in Figures 10-3 through 10-5 for tPCBs and total TEQ from dioxin-like PCB congeners, the most abundant PCB congeners, and concentrations of dioxin-like PCB congeners, respectively.

The analysis indicates that both high-end and central tendency patterns of fish and waterfowl consumption from the PSA and consumption of dairy products raised in the backyard farmer scenario (with 2 mg/kg tPCBs in soil) will result in elevated concentrations of tPCBs in breast milk. Of the abundant PCB congeners, those which account for 30 to 50% of the tPCB concentration, PCB-138, PCB-153, and PCB-180, will be substantially (80 to 140 times) elevated following RME fish consumption patterns and less, but still substantially, elevated (19 to 25 times) following RME waterfowl consumption. The predictions for the abundant congeners are consistent with the predictions based on tPCB concentrations.

A somewhat different pattern is evident for TEQ. As shown in Figure 10-3, high-end consumption patterns of fish and waterfowl result in additional concentrations of TEQ approximately 40 times higher than background. The ratio of TEQ to background is higher than the ratio of tPCBs to background for waterfowl and dairy, but lower for fish. For the dioxin-like congeners, the greatest increase in concentration over background is predicted for PCB-126, the dioxin-like congener with the highest TEF, for fish and waterfowl; for dairy, PCB-169 is predicted to have the largest increase over background. The ratio of the predicted/background TEQ for dairy consumption shown in Figure 10-3 is based on an assumed soil PCB concentration of 2 mg/kg and the ratio would be proportionately higher for soil PCB concentrations greater than 2 mg/kg.

The prediction of concentrations of PCBs in breast milk from consumption of fish was based on fish tissue concentrations from the PSA (Reaches 5 and 6). The concentrations of PCBs decrease in fish in the downstream reaches and the predicted concentrations of PCBs in breast milk decrease proportionately. The EPC for fish in Rising Pond (Reach 8) is 70% of the EPC for fish in the PSA. Assuming similar congener patterns (BBL and QEA, 2003), the elevations above background listed in Tables 10-16 and 10-17 would all decrease to 70% of the value in the table.

Concentrations of PCBs in breast milk resulting from direct contact exposure to soil and sediment can be predicted by comparing the ADD for tPCB for the consumption scenarios with those from direct contact. The central tendency ADD for the backyard dairy scenario, based on example calculations assuming 2 ppm PCBs in soil, is 7E-05 mg/kg-d (Table 10-21). By comparison, one of the highest (direct contact) risks is associated with angling in EA 59A, where the RME ADD for an adult angler is 2E-05 mg/kg-d, or 3.5 times lower. For the CTE backyard dairy scenario, the predicted PCB concentration due to consuming milk from cows raised on soil with a concentration of 2 ppm PCBs is 2 times the anticipated background concentration. Thus, the highest expected added tPCB concentration in breast milk for a high-end direct contact scenario is 2 divided by 3.5, or less than the anticipated background. Consistent with the observation in New Bedford (Korrick and Altschul, 1998), no elevation in breast milk concentrations of PCBs is anticipated as a result of direct contact exposure to soil and sediment.

There are several uncertainties associated with the prediction of breast milk concentrations of PCBs and with the background concentrations selected for comparison. The uncertainties associated with the ADD parameters are discussed in detail in Section 8 of this volume and in Appendix C. In addition to the uncertainty associated with the development of the exposure parameters for the HRA population, the consumption rates may somewhat overestimate exposure for adult women because male and female consumption rates were averaged and females generally consume smaller meal sizes. On the other hand, the body weight used for the dose calculation was somewhat high for females, which would lead to an underestimate of dose. These uncertainties are in opposite directions, and may cancel each other out.

The half-life of elimination of PCBs from the body selected for all of the calculations was a central tendency estimate of 6 years. The data for individual congeners ranged from 1 year to infinity.

Table 10-16

Predicted Concentration of Congeners in Human Milk Fat, RME Fish Consumption in the PSA

	EPC[a] (mg/kg)	ADD (mg/kg-d)	Predicted RME Milk Fat (mg/kg lipid)	Mean Background Concentrations[b] (mg/kg lipid)	Ratio Predicted RME Milk Fat / Mean Background Concentrations[b]
PCB, Total	15.91	5.44E-03	51.54	0.320	161.1
PCB Congeners					
PCB-105	0.12	4.23E-05	0.40	0.006	66.8
PCB-118	0.19	6.57E-05	0.62	0.035	17.8
PCB-126	0.003	1.06E-06	0.01	0.00008	132.1
PCB-138	1.51	5.15E-04	4.88	0.042	116.2
PCB-153	1.63	5.58E-04	5.29	0.06	88.2
PCB-156	0.06	2.06E-05	0.19	0.009	21.7
PCB-169	0.0002	8.20E-08	0.001	0.00004	19.9
PCB-180	1.76	6.00E-04	5.69	0.041	138.7

Table 10-17

Predicted Concentration of Congeners in Milk Fat, Central Tendency Fish Consumption in the PSA

	EPC[a] (mg/kg)	ADD (mg/kg-d)	Predicted CTE Milk Fat (mg/kg)	Mean Background Concentrations[b] (mg/kg)	Ratio Predicted CTE Milk Fat/ Mean Background Concentrations[b]
PCB, Total	15.91	7.86E-04	7.46	0.320	23.3
PCB Congeners					
PCB-105	0.12	6.12E-06	0.06	0.006	9.7
PCB-118	0.19	9.51E-06	0.09	0.035	2.6
PCB-126	0.003	1.53E-07	0.001	0.00008	19.1
PCB-138	1.51	7.45E-05	0.71	0.042	16.8
PCB-153	1.63	8.08E-05	0.77	0.06	12.8
PCB-156	0.06	2.97E-06	0.03	0.009	3.1
PCB-169	0.0002	1.19E-08	0.0001	0.00004	2.9
PCB-180	1.76	8.68E-05	0.82	0.041	20.1

[a]EPCs are based on the mean of the 95th UCL of the bass/bullhead distribution and the perch/sunfish distribution concentrations of the individual distributions shown in Table 10-12.
[b] Data for all congeners from Korrick and Altschul, 1998, except PCB-126 and PCB-169, which were taken from Noren and Meironyte, 2000.
Congeners in bold are dioxin-like.

Table 10-18

Predicted Concentration of Congeners in Human Milk Fat, RME Waterfowl Consumption in the PSA

	EPC (mg/kg)	RME ADD (mg/kg-d)	Predicted RME Milk Fat (mg/kg lipid)	Mean Background Concentrations* (mg/kg lipid)	Predicted RME Milk Fat/Mean Background Concentrations*
PCB, Total	9.26	7.02E-04	6.65	0.320	20.8
PCB Congeners					
PCB-105	0.05	3.90E-06	0.04	0.006	6.2
PCB-118	0.35	2.63E-05	0.25	0.035	7.1
PCB-126	0.015	1.15E-06	0.01	0.00008	142.9
PCB-138	1.12	8.45E-05	0.80	0.042	19.1
PCB-153	2.10	1.59E-04	1.51	0.06	25.1
PCB-156	0.06	4.48E-06	0.04	0.009	4.7
PCB-169	0.0009	7.12E-08	0.001	0.00004	17.3
PCB-180	1.19	9.00E-05	0.85	0.041	20.8

Table 10-19

Predicted Concentration of Congeners in Human Milk Fat, Central Tendency Waterfowl Consumption in the PSA

	EPC (mg/kg)	CTE ADD (mg/kg-d)	Predicted CTE Milk Fat (mg/kg lipid)	Mean Background Concentrations* (mg/kg lipid)	Predicted CTE Milk Fat/Mean Background Concentrations*
PCB, Total	9.26	3.37E-04	3.19	0.320	10.0
PCB Congeners					
PCB-105	0.05	1.87E-06	0.02	0.006	3.0
PCB-118	0.35	1.26E-05	0.12	0.035	3.4
PCB-126	0.015	5.50E-07	0.01	0.00008	68.6
PCB-138	1.12	4.06E-05	0.38	0.042	9.2
PCB-153	2.10	7.64E-05	0.72	0.06	12.1
PCB-156	0.06	2.15E-06	0.02	0.009	2.3
PCB-169	0.0009	3.42E-08	0.0003	0.00004	8.3
PCB-180	1.19	4.32E-05	0.41	0.041	10.0

* Data for all congeners from Korrick and Altschul, 1998, except PCB-126 and PCB-169, which were taken from Noren and Meironyte, 2000.

Congeners in bold are dioxin-like.

Table 10-20

Predicted Concentration of Congeners in Human Milk Fat, RME Backyard Dairy Scenario

	Predicted Exposure-Backyard Dairy (2 ppm soil) (mg/kg fat)	RME ADD (mg/kg-d)	Predicted RME Milk Fat (mg/kg lipid)	Mean Background Concentrations* (mg/kg lipid)	Predicted RME Milk Fat/Mean Background Concentrations*
PCBs					
PCB, Total	0.225	1.94E-04	1.83	0.320	5.7
PCB Congeners					
PCB-105	0.00113	9.72E-07	0.01	0.006	1.5
PCB-118	0.00581	5.00E-06	0.05	0.035	1.4
PCB-126	0.000467	4.02E-07	0.004	0.00008	50.1
PCB-138	NA	-	-	0.042	-
PCB-153	NA	-	-	0.06	-
PCB-156	0.00148	1.27E-06	0.01	0.009	1.3
PCB-169	0.000303	2.61E-07	0.002	0.00004	63.4
PCB-180	NA	-	-	0.041	-

Table 10-21

Predicted Concentration of Congeners in Human Milk Fat, Central Tendency Backyard Dairy Scenario

	Predicted Exposure Backyard Dairy (2 ppm soil) (mg/kg fat)	CTE ADD (mg/kg-d)	Predicted CTE Milk Fat (mg/kg lipid)	Mean Background Concentrations* (mg/kg lipid)	Predicted CTE Milk Fat/Mean Background Concentrations*
PCBs					
PCB, Total	0.225	7.34E-05	6.96E-01	0.324	2.1
PCB Congeners					
PCB-105	0.00113	3.69E-07	3.50E-03	0.006	0.6
PCB-118	0.00581	1.90E-06	1.80E-02	0.035	0.5
PCB-126	0.000467	1.52E-07	1.45E-03	0.00008	19.0
PCB-138	NA	-	-	0.042	-
PCB-153	NA	-	-	0.06	-
PCB-156	0.00148	4.83E-07	4.58E-03	0.009	0.5
PCB-169	0.000303	9.89E-08	9.38E-04	0.00004	24.0
PCB-180	NA	-	-	0.041	-

* Data for all congeners from Korrick and Altschul, 1998, except PCB-126 and PCB-169, which were taken from Noren and Meironyte, 2000.

Congeners in bold are dioxin-like.

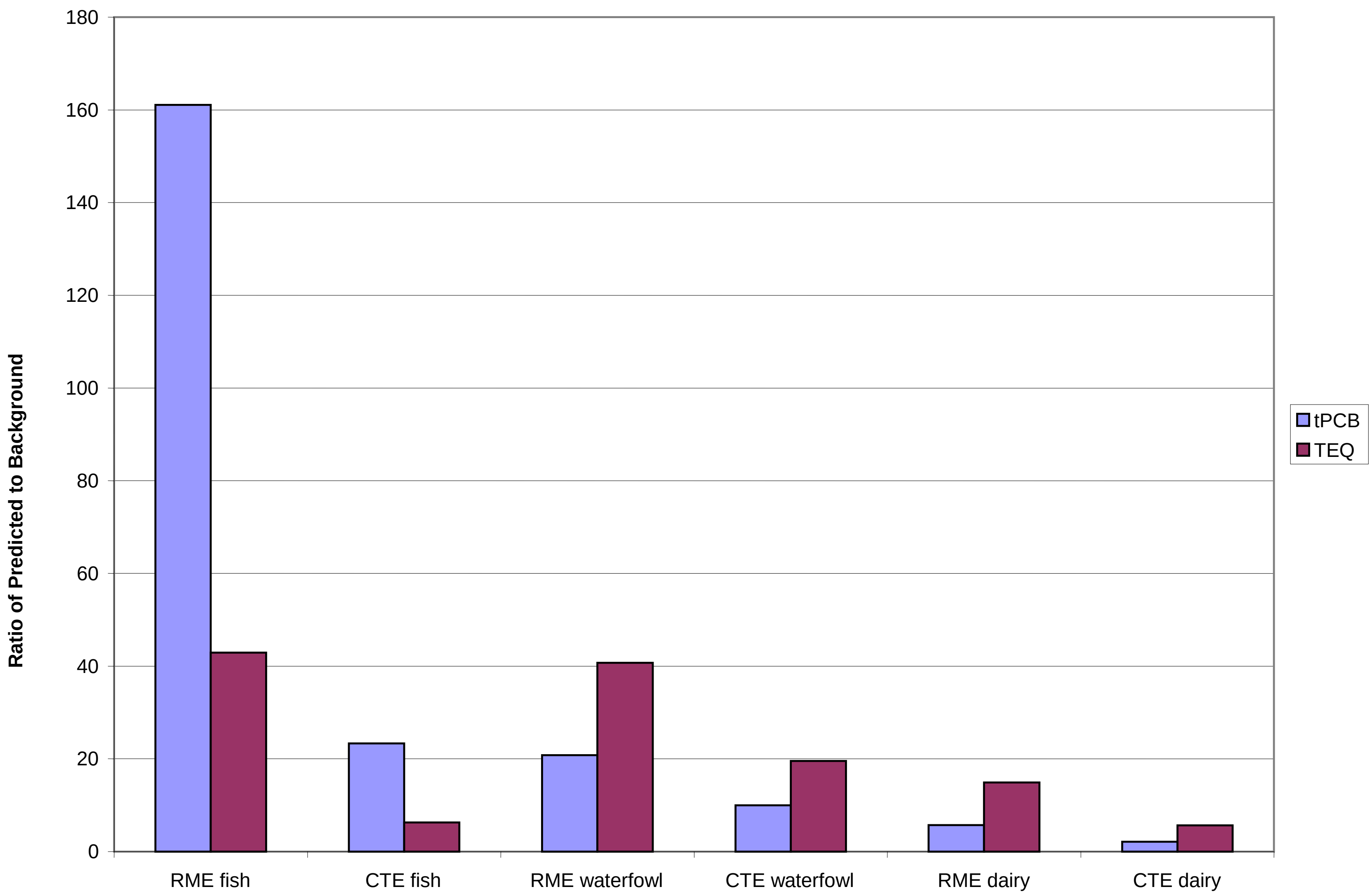

Figure 10-3 Comparison of Predicted tPCB and TEQ in Breast Milk with Background Concentrations

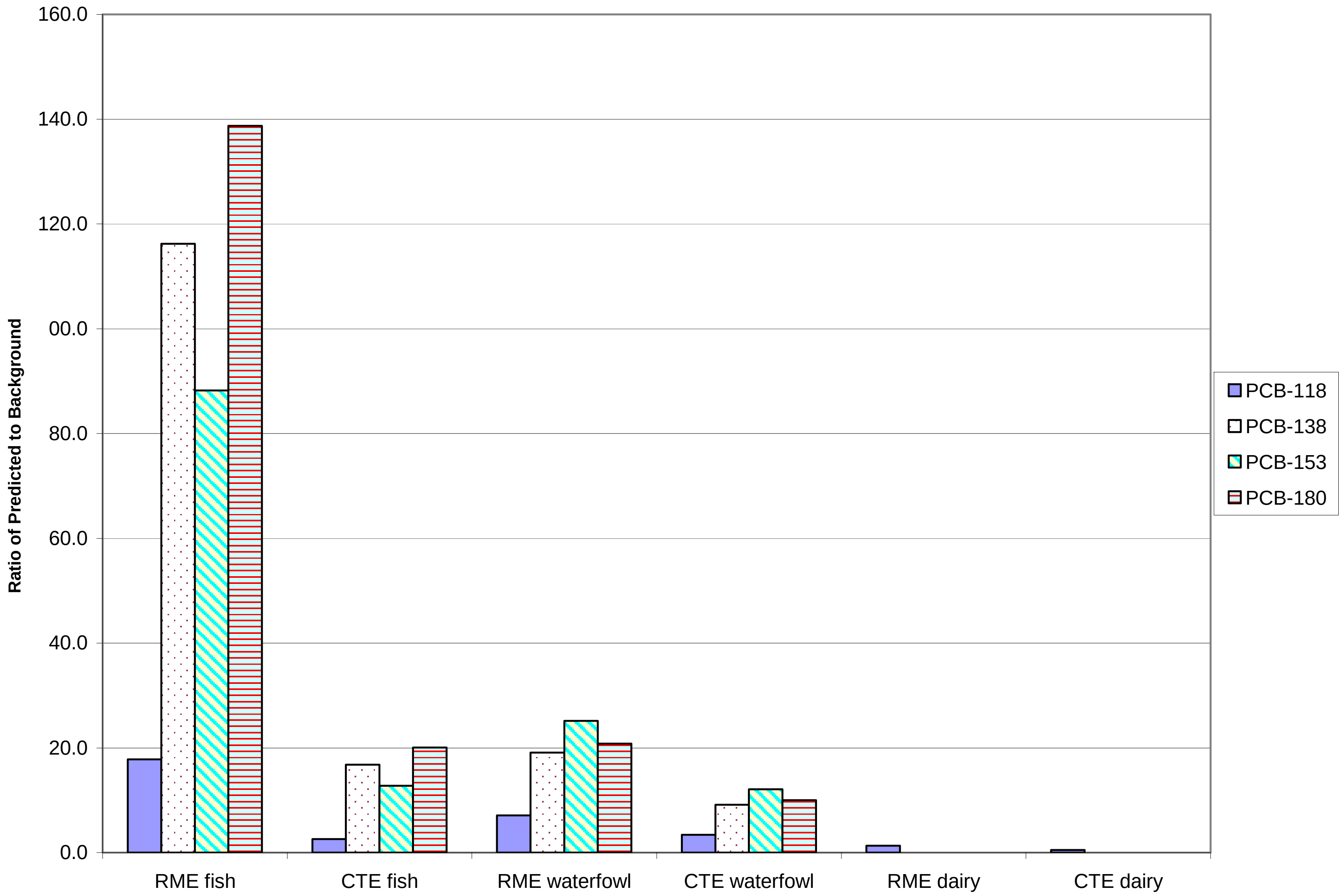

Figure 10-4 Comparison of Predicted and Background Concentrations for Abundant Congeners

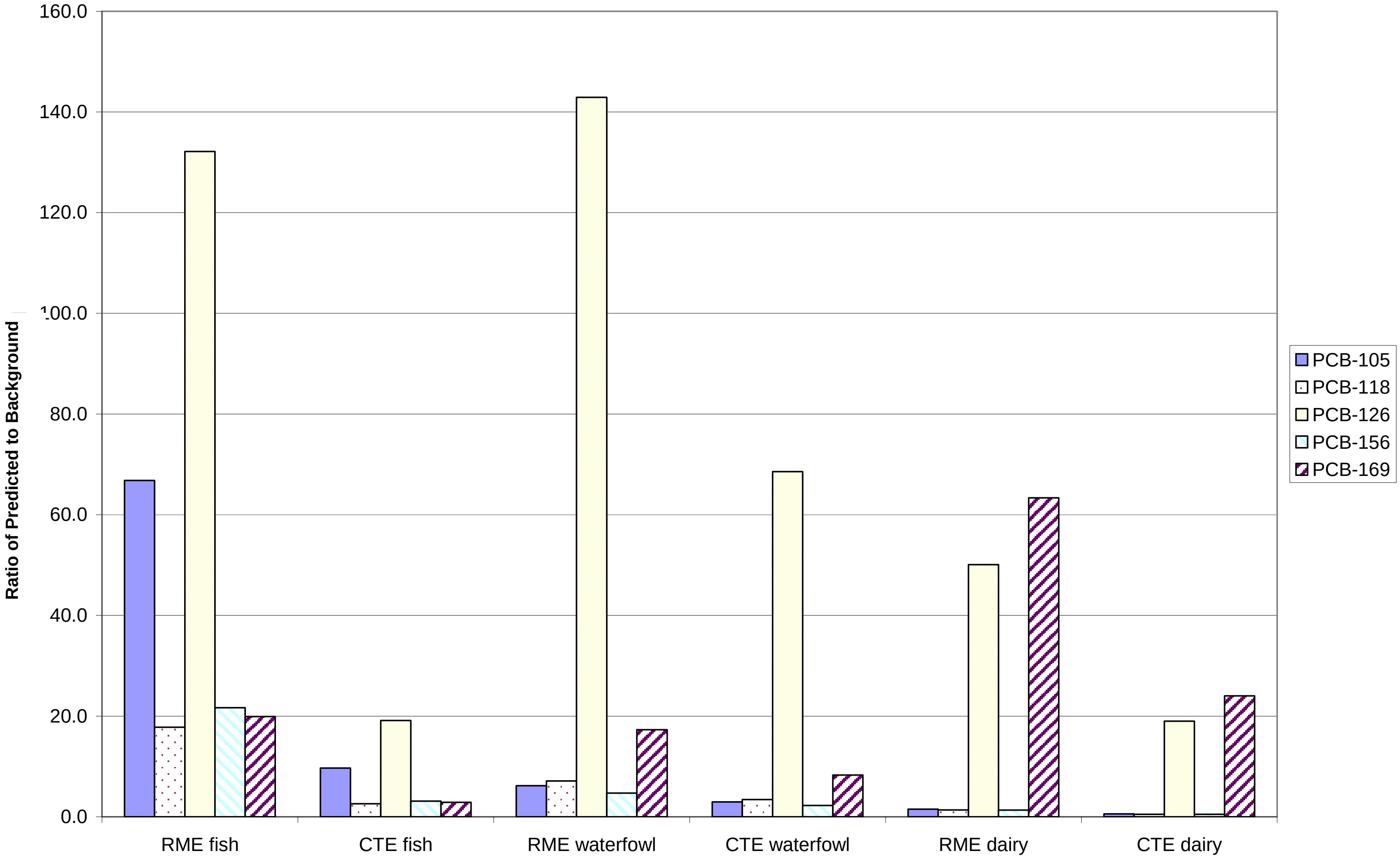

Figure 10-5 Comparison of Predicted and Background Concentrations for Dioxin-Like Congeners