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NEW BEDFORD HARBOR RISK ASSESSMENT

DRAFT

Prepared by:

TERRA, Inc.

October 1989

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1.0 INTRODUCTION

This report presents an evaluation of the human risks associated with exposure to PCBs under conditions c.rrently existing in the Upper Estuary of the Acushnet River and the New Bedford Harbor Area. This report also examines the reduction of risk that would result from capping contaminated sediments in the Upper Estuary.

Background material necessary for the characterization of potential risks currently associated with direct contact with Acushnet River Estuary and New Bedford Harbor sediments and ingestion of locally caught seafood is provided in the New Bedford Harbor (NBH) Exposure Assessment and NBH Hazard Evaluation (TERRA, Inc., October 1989). The NBH Exposure Assessment presents estimates of exposure for adults and children who may be exposed to PCBs as a result of direct contact with sediments during beachcombing or shellfishing in Area I or beachcombing in Areas II and III. This report also estimates potential PCB exposure due to ingestion of seafood caught in closed areas of New Bedford Harbor.

Human toxicological and epidemiological data and animal toxicological and carcinogenicity data were reviewed in the NBH Hazard Evaluation to assess the potential risks associated with PCB exposure. An allowable daily intake (ADI) for 54% chlorine PCB mixtures was calculated on the basis of no observable effect levels and lowest observable effect levels from human and animal studies. The ADI derived for the 54% chlorine PCB mixtures was 1 µg/kg/day. This ADI may also be applied to 42% chlorine PCB mixtures. Data supporting the establishment of a 1 µg/kg/day ADI for these PCB mixtures are discussed in detail in the NBH Hazard Evaluation and are not reviewed in detail in this document.

Quantitative estimates of risk from PCB exposure are sometimes based on carcinogenicity studies of 60% chlorine PCB mixtures without regard to the chlorine content of a mixture. Often, the cancer potency factor derived for Aroclor 1260 is applied in risk calculations for lesser chlorinated PCB mixtures. As discussed in the NBH Hazard Evaluation, there are significant toxicological differences between PCB mixtures with different chlorine contents, indicating there is little scientific basis for this default risk policy. Risks are exaggerated when an EPA-derived cancer potency factor of 7.7 $(mg/kg/day)^{-1}$ is used to characterize risks from PCBs. However, in spite of the flaws associated with this policy, this report presents risk estimates calculated using a cancer potency factor of 7.7 $(mg/kg/day)^{-1}$. This should not be construed as an endorsement of the flawed EPA default policy. Rather, this report recognizes that this cancer potency factor will be used by others to calculate risks from dose estimates presented in the NBH Exposure Assessment. For this reason, they are presented along with other risk calculations.

In addition to the flaw associated with the above approach, the animal study (Norback and Weltman, 1985) used by the EPA as a basis for calculating the cancer potency factor suffers serious limitations. These limitations are reviewed in the NBH Hazard Evaluation. Reanalyses of animal carcinogenicity bioassays of 60% chlorine PCB mixtures by Kimbrough et al. (1975), Schaeffer (1984), and Norback and Weltman (1985) are the basis for the lower cancer potency factor (0.18 $(mg/kg/day)^{-1}$) that is used in this document for 60% chlorine PCB mixtures. As discussed in the NBH Hazard Evaluation, recent scientific analyses of current EPA risk assessment methods indicate that risk estimates calculated using EPA methods and cancer potency factors will lead to unrealistically high estimates of risk.

2.0 ANALYSIS OF BASELINE HUMAN HEALTH RISKS

Baseline human health risks are those risks associated with the Acushnet River Estuary and the New Bedford Harbor in their unremediated states. Baseline risks are sometimes called "no action" risks in consideration of the adverse health effects which may occur if no remediation or other action is taken to limit human exposure to site contaminants. Assuming baseline conditions, ranges of PCB doses were calculated for adult, older child, and young child receptors potentially exposed to PCB-containing sediments during shellfishing or beachcombing activities. The assumptions used to calculate PCB doses for the adult and child receptors are discussed in the NBH Exposure Assessment.

2.1 Risk Estimates

2.1.1 Risks Posed By Direct Contact With Sediment in Areas I, II, and III

Absorbed PCB doses calculated for the adult, older child, and young child beachcomber and shellfisher are presented below. Exposure assumptions were presented in the New Bedford Harbor Exposure Assessment and will not be repeated here. The estimated doses presented below span a range of hypothetical exposures which may occur in Areas I, II, and III (as these Areas are defined in Ebasco, 1989) of the New Bedford Harbor Area. Risks calculated using the 7.7 $(mg/kg/day)^{-1}$ cancer potency factor are given in parenthesis with the notation "EPA-cpf".

Cancer risks are commonly expressed using the notation "1 E-06". This notation is equivalent to "1×10^{-6}" or "one excess cancer in 1 million persons." The EPA considers 1 E-04 to 1 E-07 as an acceptable lifetime risk range for Superfund sites.

Table 2-1
Risks Associated with Direct Contact with PCBs in Sediment

Area I

Receptor	Exposure	PCB Dose Per Exposure Event (µg/kg)	Ratio of PCB Dose Per Exposure Event to ADI (1 µg/kg/day)	Average Lifetime PCB Dose (µg/kg/day)	Cancer Risk	
					7.7 $(mg/kg/day)^{-1}$	0.18 $(mg/kg/day)^{-1}$
Adult						
Beachcomber	6 exposures/yr for 9 yr	0.0506	0.0506	9.98 E-05	7.68 E-07	1.80 E-08
Beachcomber	18 exposures/yr for 9 yr	0.0506	0.0506	2.99 E-04	2.30 E-06	5.38 E-08
Beachcomber	6 exposures/yr for 30 yr	0.0506	0.0506	3.33 E-04	2.56 E-06	5.99 E-08
Beachcomber	18 exposures/yr for 30 yr	0.0506	0.0506	9.98 E-04	7.68 E-06	1.80 E-07
Shellfisher	6 exposures/yr for 9 yr	0.130	0.130	2.56 E-04	1.97 E-06	4.61 E-08
Shellfisher	18 exposures/yr for 9 yr	0.130	0.130	7.67 E-04	5.91 E-06	1.38 E-07
Shellfisher	6 exposures/yr for 30 yr	0.130	0.130	4.68 E-04	3.60 E-06	8.42 E-08
Shellfisher	18 exposures/yr for 30 yr	0.130	0.130	2.56 E-03	1.97 E-05	4.61 E-07
Older Child						
Beachcomber	6 exposures/yr for 9 yr	0.121	0.121	1.35 E-04	1.04 E-06	2.43 E-08
Beachcomber	18 exposures/yr for 9 yr	0.121	0.121	4.06 E-04	3.13 E-06	7.31 E-08
Shellfisher	6 exposures/yr for 9 yr	0.270	0.270	3.02 E-04	2.33 E-06	5.44 E-08
Shellfisher	18 exposures/yr for 9 yr	0.270	0.270	9.07 E-04	6.98 E-06	1.63 E-07

Table 2-1 (continued)

Area II

Receptor	Exposure	PCB Dose Per Exposure Event (µg/kg)	Ratio of PCB Dose Per Exposure Event to ADI (1 µg/kg/day)	Average Lifetime PCB Dose (µg/kg/day)	Cancer Risk	
					$(7.7\ mg/kg/day)^{-1}$	$(0.18\ mg/kg/day)^{-1}$
Adult						
Beachcomber	**12 exposures/yr for 9 yr**	2.04 E-03	2.04 E-03	8.05 E-06	6.20 E-08	2.52 E-09
Beachcomber	**24 exposures/yr for 9 yr**	2.04 E-03	2.04 E-03	1.61 E-05	1.24 E-07	2.90 E-09
Beachcomber	**12 exposures/yr for 30 yr**	2.04 E-03	2.04 E-03	2.68 E-05	2.06 E-07	4.82 E-09
Beachcomber	**24 exposures/yr for 30 yr**	2.04 E-03	2.04 E-03	5.37 E-05	4.13 E-07	9.67 E-09
Older Child						
Beachcomber	**12 exposurea/yr for 9 yr**	6.64 E-03	6.64 E-03	1.48 E-05	1.14 E-07	2.66 E-09
Beachcomber	**24 exposures/yr for 9 yr**	6.64 E-03	6.64 E-03	2.96 E-05	2.28 E-07	5.33 E-09

Table 2-1 (continued)

Area III

Receptor	Exposure	PCB Dose Per Exposure Event (μg/kg)	Ratio of PCB Dose Per Exposure Event to ADI (1 μg/kg/day)	Average Lifetime PCB Dose (μg/kg/day)	Can.er Risk	
					(7.7 mg/kg/day)-1	(0.18 mg/kg/day)-1
Adult						
Beachcomber	18 exposurea/yr for 9 yr	3.89 E-04	3.89 E-04	2.30 E-06	1.77 E-08	4.14 E-10
Beachcomber	54 exposures/yr for 9 yr	3.89 E-04	3.89 E-04	6.90 E-06	5.31 E-08	1.24 E-09
Beachcomber	18 exposures/yr for 30 yr	3.89 E-04	3.89 E-04	7.67 E-06	5.91 E-08	1.38 E-09
Beachcomber	54 exposures/yr for 30 yr	3.89 E-04	3.89 E-04	2.30 E-05	1.77 E-07	4.14 E-09
Older Child						
Beachcomber	18 exposures/yr for 9 yr	1.26 E-03	1.26 E-03	4.23 E-06	3.26 E-08	7.61 E-10
Beachcomber	54 exposures/yr for 9 yr	1.26 E-03	1.26 E-03	1.27 E-05	9.78 E-08	2.29 E-09
Younger Child						
Beachcomber	18 exposures/yr for 5 yr	1.18 E-02	1.18 E-02	9.06 E-06	6.98 E-08	1.63 E-09
Beachcomber	54 exposures/yr for 5 yr	1.18 E-02	1.18 E-02	2.72 E-05	2.09 E-07	4.90 E-09

2.1.1.1 Area I

The highest PCB dose per exposure event was calculated for the older child shellfisher. However, the dose calculated (0.270 µg/kg/day) is below the 1 µg/kg/day ADI derived for 54% chlorine PCB mixtures. Doses calculated for the adult beachcomber, older child beachcomber, and adult shellfisher were 0.130 µg/kg/day or lower.

All risks calculated for the adult and older child receptor directly exposed to sediments in Area I were lower than the 1 E-04 upper bound limit set by EPA for acceptable risk, regardless of the cancer potency factor used to calculate risk. The cancer risk associated with contact with sediment 18 times per year for 30 years was 4.61 E-07 (1.97 E-05, EPA-cpf) for the adult shellfisher. Cancer risks for the older child shellfisher were lower than those calculated for the adult. At the highest exposure level (18 exposure events per year for 9 years), the older child shellfisher was calculated to have a lifetime cancer risk of 6.98 E-06 (1.63 E-07, EPA-cpf). Risks for the lesser exposed older child receptors were equal to or lower than 7.31 E-08 (or 3.13 E-06, EPA-cpf). Again, application of cancer potency factors derived from studies of 60% chlorine PCB mixtures are misapplied when assessing risks posed by exposure to 54% and 42% chlorine PCB mixtures, but the risk calculated by using the 7.7 $(mg/kg/day)^{-1}$ cancer potency factor derived by the EPA is within the acceptable range of risks prescribed by the EPA.

2.1.1.2 Area II

The absorbed doses of PCBs calculated to occur per exposure event in Area II were lower than those calculated for Area I. The adult and older child beachcomber were calculated to receive absorbed PCB doses of 2.04 E-03 µg/kg/day and 6.64 E-03 µg/kg/day, respectively. Both doses are well below the 1 µg/kg/day ADI.

Lifetime cancer risks calculated for the adult and child beachcomber in Area II were below 1 E-07 (or below 1 E-06, EPA-cpf). The risks calculated for these receptors are within the risk range considered acceptable by the EPA.

2.1.1.3 Area III

Due to the presence of public beaches in Area III, the potential exposure of a young child (age 1 to 6) to PCBs in sediment was also considered. The absorbed PCB dose per exposure event for the young child was 1.18 E-02 μg/kg/day. Absorbed doses of PCBs per exposure event for the adult and older child beachcomber were 3.89 E-04 μg/kg/day and 1.26 E-03 μg/kg/day, respectively. The absorbed dose of PCBs for the young child, older child, and adult were all considerably lower than the 1 μg/kg/day ADI.

Lifetime cancer risks for the adult, older child, and young child were below 1 E-08 (or below 3 E-07, EPA-cpf). All risks calculated for the adult, older child, and young child receptors in Area III were within or below the risk range acceptable to the EPA.

2.1.2 Seafood Consumer Risks

Absorbed doses of PCB were calculated for the adult, older child, and young child seafood consumer considering both "typical" and heavy exposure. A discussion of this exposure scenario and exposure variables is presented in the New Bedford Harbor Exposure Assessment. Estimated PCB doses from ingestion of PCBs in seafood are presented in Table 2-2.

Table 2-2

Risks Associated With Consumption of Seafood from Areas I, II, III, and IV

Receptor	Average Seafood Consumption	Fraction of Total Fish Intake from Areas I-IV	Daily PCB Exposure (µg/kg/day)	Ratio of Daily PCB Exposure to ADI	Years Exposed	Average Lifetime Daily Dose (µg/kg/day)	Cancer Risk	
							7.7 $(mg/kg/day)^{-1}$	0.18 $(mg/kg/day)^{-1}$
Adult	16.3	0.2	1.51E-02	1.51E-02	9	1.81E-03	1.39E-05	3.26E-07
	16.3	0.5	3.77E-02	3.77E-02	9	4.53E-03	3.49E-05	8.15E-07
	16.3	0.2	1.51E-02	1.51E-02	30	6.04E-03	4.65E-05	1.09E-06
	16.3	0.5	3.77E-02	3.77E-02	30	1.51E-02	1.16E-04	2.72E-06
	46.5	0.2	4.30E-02	4.30E-02	9	5.17E-03	3.98E-05	9.30E-07
	46.5	0.5	1.08E-01	1.08E-01	9	1.29E-02	9.94E-05	2.32E-06
	46.5	0.2	4.30E-02	4.30E-02	30	1.72E-02	1.33E-04	3.10E-06
	46.5	0.5	1.08E-01	1.08E-01	30	4.30E-02	3.31E-04	7.75E-06
Older Child	10.1	0.2	1.65E-02	1.65E-02	9	1.12E-03	8.64E-06	2.02E-07
	10.1	0.5	4.13E-02	4.13E-02	9	2.80E-03	2.16E-05	5.05E-07
	26.8	0.2	4.39E-02	4.39E-02	9	2.98E-03	2.29E-05	5.36E-07
	26.8	0.5	1.10E-01	1.10E-01	9	7.44E-03	5.73E-05	1.34E-06
Younger Child	6.2	0.2	2.46E-02	2.46E-02	5	3.83E-04	2.95E-06	6.89E-08
	6.2	0.5	6.16E-02	6.16E-02	5	9.57E-04	7.37E-06	1.72E-07
	16.5	0.2	6.56E-02	6.56E-02	5	1.02E-03	7.84E-06	[illegible].83E-07
	16.5	0.5	1.64E-01	1.64E-01	5	2.55E-03	1.96E-05	4.58E-07

Daily PCB doses associated with consumption of seafood from the New Bedford Harbor Area ranged from 1.64 E-01 µg/kg/day for the young child assumed to consume an average of 16.5 g of seafood per day, 50% of which was assumed to come from closed areas of the New Bedford Harbor, to 1.72 E-02 µg/kg/day for the least exposed adult. All daily absorbed doses of PCBs due to seafood consumption were below the 1 µg/kg/day ADI for all receptors.

Lifetime cancer risks associated with seafood consumption varied considerably with receptor, the amount of seafood consumed, and the cancer potency factor used to calculate risks. The adult consuming an average of 46.5 g of seafood per day for 30 years, 50% of which was assumed to come from closed fishing areas, had a lifetime cancer risk of 7.75 E-06 (3.31 E-04, EPA-cpf). Lifetime cancer risks calculated for the most heavily exposed older child and young child seafood consumer were 1.34 E-06 (5.73 E-05, EPA-cpf) and 4.58 E-07 (1.96 E-05, EPA-cpf), respectively. All risks calculated using the 0.18 $(mg/kg/day)^{-1}$ cancer potency factor were below 1 E-05 and within the risk range considered acceptable by the EPA.

3.0 ANALYSIS OF HUMAN HEALTH RISK REDUCTION ASSOCIATED WITH THE CAPPING ALTERNATIVE

Capping has been proposed as a remedial alternative for Upper Estuary sediments with PCB concentrations in excess of 50 mg/kg. This remedial alternative calls for sediments in excess of 50 ppm to be overlain with a liner and clean sand. Such a process would limit human contact to those sediments containing 50 ppm or less of PCB mixtures. The reduction in human PCB doses afforded by this remedial action is assessed below for the beachcomber and shellfisher receptors and the seafood consumer.

3.1 Post-Remediation Risks

3.1.1 Beachcomber and Shellfisher Risks

Absorbed doses of PCBs and the risks associated with these doses are presented below for the adult and older child beachcomber and shellfisher. With the exception of PCB concentration in sediment and an increased number of post-remediation exposure events for the beachcomber (18 and 54 exposures per year) caused by the improved appearance of the beach, this exposure scenario assumes the same exposure conditions as those assumed for baseline conditions in Area I. Post remediation exposures and risks were not calculated for a young child (1 to 6 years old) since children this age were considered incapable of accessing locations in the Acushnet River Estuary where remediation would occur.

Exposures and risks associated with direct contact with 50 ppm in sediment are listed in Table 3-1. Absorbed doses of PCB per exposure event were 8.43 E-03 and 2.02 E-02 μg/kg/day for the adult and older child beachcomber, respectively. These doses are well below the 1 μg/kg/day ADI derived for 54% chlorine PCB mixtures. Likewise, doses for the adult and older child shellfisher were below the 1 μg/kg/day ADI (2.16 E-02 and 4.51 E-02 μg/kg/day, respectively). In each case, post remediation PCB doses are 83% lower than absorbed doses of PCBs calculated to occur from contact with sediments under baseline conditions (Table 2-1).

Post remediation lifetime cancer risk estimates were also lower than risks calculated to result from contact with unremediated sediments. Cancer risks for adult and older child beachcombers and shellfishers were below the 1 E-07 risk level (or 4 E-06 risk level, EPA-cpf). Regardless of the cancer potency factor used to calculate risks, all post-remedial risks were below the 1E-05 risk level and within the 1 E-04 and 1 E-07 risk range considered acceptable by the EPA. .

Table 3-1

Post Remediation Risks: Risks Associated with Direct Contact with 50 ppm PCBs in Sediment

Receptor	Exposure	PCB Dose Per Exposure Event (µg/kg)	Ratio of PCB Dose Per Exposure Event to ADI (1 µg/kg/day)	Average Lifetime PCB Dose (µg/kg/day)	Cancer Risk	
					7.7 (mg/kg/day)$^{-1}$	0.18 (mg/kg/day)$^{-1}$
Adult						
Beachcomber	18 exposures/yr for 9 yr	8.43 E-03	8.43 E-03	4.99 E-05	3.59 E-07	8.34 E-09
Beachcomber	54 exposures/yr for 9 yr	8.43 E-03	8.43 E-03	1.50 E-04	1.16 E-06	2.70 E-08
Beachcomber	18 exposures/yr for 30 yr	8.43 E-03	8.43 E-03	1.66 E-04	1.28 E-06	2.99 E-08
Beachcomber	54 exposures/yr for 30 yr	8.43 E-03	8.43 E-03	4.99E-04	3.84 E-06	8.98 E-08
Shellfisher	6 exposures/yr for 9 yr	2.16 E-02	2.16 E-02	4.26 E-05	3.28 E-07	7.67 E-09
Shellfisher	18 exposures/yr for 9 yr	2.16 E-02	2.16 E-02	1.28 E-04	9.86 E-07	2.30 E-08
Shellfisher	6 exposures/yr for 30 yr	2.16 E-02	2.16 E-02	7.80 E-05	6.01 E-07	1.40 E-08
Shellfisher	18 exposures/yr for 30 yr	2.16 E-02	2.16 E-02	4.26 E-04	3.28 E-06	7.67 E-08
Older Child						
Beachcomber	18 exposures/yr for 9 yr	2.02 E-02	2.02 E-02	6.76 E-05	5.21 E-07	1.22 E-08
Beachcomber	54 exposures/yr for 9 yr	2.02 E-02	2.02 E-02	2.03 E-04	1.56 E-06	3.65 E-08
Shellfisher	6 exposures/yr for 9 yr	4.51 E-02	4.51 E-02	5.04 E-05	3.88 E-07	9.07 E-09
Shellfisher	18 exposures/yr for 9 yr	4.51 E-02	4.51 E-02	1.51 E-04	1.16 E-06	2.72 E-08

3.1.2 Seafood Consumer Risks

Post-remediation concentrations of PCBs in biota were calculated by Balsam Environmental Consultants (Balsam, 1989). These data are listed below.

Species	Calculated Body Burden (μg/g or ppm)
Lobster	0.200-0.330
Winter flounder	0.450-0.740
Crab	0.200-0.330
Hard clam	0.074-0.120
Polychaete	0.650-1.100

A concentration of PCBs may be calculated from the above data to represent edible seafood levels following remediation. To be consistent with data presented in the NBH Exposure Assessment, data from the lobster, winter flounder, and clam will be used to calculate representative PCB concentrations in edible biota. A geometric mean of these concentrations is 0.078 ppm. This number is calculated by conservatively using the high number of the range of concentrations. As discussed in the NBH Exposure Assessment, the concentration of PCBs in seafood is reduced 50% to account for the effect of cooking. Winter flounder body burden PCB concentrations were adjusted using a factor of 0.13 (Ebasco, 1989) to estimate edible tissue concentrations.

Absorbed doses of PCBs for the adult, older child, and younger child seafood consumers may be calculated using 0.078 ppm as a representative concentration of PCBs in edible seafood. Absorbed doses and the risks posed by these doses are presented in Table 3-2.

Table 3-2

Post Remediation Risks Associated With Consumption of Seafood from the Upper Estuary

Receptor	Average Seafood Consumption	Fraction of Total Fish Intake from Upper Estuary	Daily PCB Exposure (µg/kg/day)	Ratio of Daily PCB Exposure to ADI	Years Exposed	Average Lifetime Daily Dose (µg/kg/day)	*Cancer Risk	
							7.7 $(mg/kg/day)^{-1}$	0.18 $(mg/kg/day)^{-1}$
Adult	16.3	0.2	3.63E-03	3.63E-03	9	4.36E-04	3.36E-06	7.85E-08
	16.3	0.5	9.08E-03	9.08E-03	9	1.09E-03	8.39E-06	1.96E-07
	16.3	0.2	3.63E-03	3.63E-03	30	1.45E-03	1.12E-05	2.62E-07
	16.3	0.5	9.08E-03	9.08E-03	30	3.63E-03	2.80E-05	6.54E-07
	46.5	0.2	1.04E-02	1.04E-02	9	1.24E-03	9.58E-06	2.24E-07
	46.5	0.5	2.59E-02	2.59E-02	9	3.11E-03	2.39E-05	5.60E-07
	46.5	0.2	1.04E-02	1.04E-02	30	4.15E-03	3.19E-05	7.46E-07
	46.5	0.5	2.59E-02	2.59E-02	30	1.04E-02	7.98E-05	1.87E-06
Older Child	10.1	0.2	3.98E-03	3.98E-03	9	2.70E-04	2.08E-06	4.86E-08
	10.1	0.5	9.95E-03	9.95E-03	9	6.75E-04	5.20E-06	1.22E-07
	26.8	0.2	1.06E-02	1.06E-02	9	7.17E-04	5.52E-06	1.29E-07
	26.8	0.5	2.64E-02	2.64E-02	9	1.79E-03	1.38E-05	3.23E-07
Younger Child	6.2	0.2	5.93E-03	5.93E-03	5	9.21E-05	7.09E-07	1.66E-08
	6.2	0.5	1.48E-02	1.48E-02	5	2.30E-04	1.77E-06	4.15E-08
	16.5	0.2	1.58E-02	1.58E-02	5	2.45E-04	1.89E-06	4.41E-08
	16.5	0.5	3.95E-02	3.95E-02	5	6.13E-04	4.72E-06	1.10E-07

The risks and exposures calculated in Table 3-2 are not directly comparable with those calculated for baseline conditions because baseline risk estimates accounted for consumption of seafood taken from the Acushnet River Estuary and New Bedford Harbor and not just the Acushnet River Estuary. Although precise estimates of the decrease in PCB levels in biota taken from other Areas following capping are not available, it is reasonable to assume that, like PCB concentrations in biota from the Upper Estuary, PCB levels would also decline in biota in New Bedford Harbor. Thus, the risks calculated in Table 3-2 represent an upper bound of risks that would be associated with consumption of seafood taken from waters in the Greater New Bedford Harbor Area.

Absorbed daily doses of PCBs were below 2.59 E-02 µg/kg/day for the adult, older child, and younger child in each case (Table 3-2). The highest daily dose of PCBs was calculated for the young child (3.95 E-02 µg/kg/day).

Lifetime cancer risks associated with consumption of seafood taken from the Upper Estuary after capping are below 2 E-06 (8 E-05, EPA-cpf). The highest risk was calculated for the adult consuming an average of 46.5 g of seafood per day for 30 years. The risk associated with this level of PCB exposure was calculated to be 1.87 E-06 (7.98 E-05, EPA-cpf). Using this factor, cancer risks to older children and young children were calculated to be approximately 3 E-07 (1.4 E-05, EPA-cpf) and lower.

4.0 CONCLUSIONS REGARDING THE HEALTH RISKS ASSOCIATED WITH PCB EXPOSURE

The risk characterization presented above is based on the toxicological evaluation of 42% and 54% chlorine PCB mixtures presented in the New Bedford Harbor Hazard Evaluation and the exposure estimates presented in the New Bedford Harbor Exposure Assessment. An allowable daily intake of 1 µg/kg/day was derived based on a thorough analysis of animal and human toxicological data concerning 42% and 54% chlorine PCB mixtures.

Evidence for the carcinogenicity of 54% chlorine PCB mixtures is, at best equivocal and for 42% chlorine PCB mixtures, negative. However, this assessment has conservatively used the cancer potency factor used by the EPA (7.7 $(mg/kg/day)^{-1}$) fo- 60% chlorine PCB mixtures to calculate lifetime cancer risks associated with exposures from direct contact with sediment and ingestion of seafood in waters taken from the Acushnet River Estuary and the New Bedford Harbor. However, as reviewed in the NBH Hazard Evaluation, this cancer potency factor is misapplied when used to calculate risks posed by exposure to 42% and 54% chlorine PCB mixtures. In the final analysis, use of this factor provides risk estimates which are unrealistically high and lacking in credibility.

As an alternative to the risks calculated using the EPA-derived cancer potency factor, the cancer potency factor developed in the NBH Hazard Evaluation of 0.18 $(mg/kg/day)^{-1}$ was also used to calculate cancer risks. This cancer potency factor was also derived from animal studies of 60% chlorine PCB mixtures and is therefore extremely conservative when applied to an assessment of the risks associated with 54% and 42% chlorine PCB mixtures. However, the 0.18 $(mg/kg/day)^{-1}$ cancer potency factor was derived from consideration of three studies of 60% chlorine PCB mixtures and not the single, methodologically flawed study used by the EPA.

4.1 Baseline Risks

Direct contact with PCBs in sediments poses little risk even when the extremely conservative 7.7 $(mg/kg/day)^{-1}$ cancer potency factor is used to calculate risks posed by direct exposure to sediments containing 54% and 42% chlorine PCB mixtures. The highest risk calculated to occur from direct contact with sediment was that for the adult shellfisher assumed to contact sediments in Area I 18 times per year for 30 years. The lifetime cancer risk associated with this level of exposure was calculated to be 4.61 E-07 (1.97 E-05, EPA-cpf), well within the EPA acceptable risk range. In the final analysis, risks posed by all other exposures to PCBs in sediments in Areas I, II, and III for the adult, older child, and young child are below 1

E-06 (1 E-05, EPA-cpf). Thus, activities which may hypothetically occur in Areas I, II, and III (as defined by Ebasco, 1989) such as beachcombing and shellfishing are associated with risk levels which are clearly within the 1 E-04 to 1 E-07 range of risks allowed by the EPA.

When compared to exposures from direct contact with sediment, higher absorbed PCB doses were calculated to occur from the daily consumption of seafood taken from Acushnet River Estuary and New Bedford Harbor. For this reason, calculated risk estimates were also higher for consumers of locally caught seafood. Calculated risks were below 1 E-05 (4 E-04, EPA-cpf).

4.2 Risk Reduction from Capping

Capping sediments containing PCB concentrations in excess of 50 ppm reduced doses of PCBs for adult and child beachcombers and shellfishers in Area I to 17% of doses calculated for baseline conditions. Given the exposure reduction provided by capping, lifetime cancer risks associated with direct contact with sediment were below 1 E-07 (1 E-05, EPA-cpf) .

The degree of reduction of PCB concentrations in biota from the New Bedford Harbor provided by capping sediments in the Upper Estuary of the Acushnet River cannot be definitely calculated; and therefore, it is difficult to assess the reduction of risk afforded by capping contaminated sediments in the Upper Estuary. However, using estimates of post-remediation PCB concentrations in Upper Estuary biota and conservatively assuming that all local seafood catch is obtained from the Upper Estuary (Balsam, 1989), risks are reduced below those calculated to result from consumption of seafood presently taken from all areas in the New Bedford Harbor. Risks due to consumption of lobster, winter flounder, and clams were below the 2 E-06 level (8 E-05, EPA-cpf) in all cases for the adult, older child, and young adult. The range of risks calculated are within the 1 E-04 to 1 E-07 levels prescribed by EPA.

5.0 REFERENCES

Balsam 1989. A Remedial Action Program- New Bedford Harbor Superfund Site, Draft. October 16, 1989

Ebasco 1989. Draft Final Baseline Public Health Risk Assessment; New Bedford Harbor Feasibility Study. August 1989.