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# EPA Superfund Explanation of Significant Difference for the Record of Decision:

## Commencement Bay, Near Shore/Tide Flats, Operable Unit 01 - Sediments & Operable Unit 05 - Source, Pierce County, WA 7/28/1997

## EXPLANATION OF SIGNIFICANT DIFFERENCES
## COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE

## I. INTRODUCTION

**Site Name and Location**

Commencement Bay Nearshore/Tideflats Superfund Site
Tacoma, Pierce County, Washington
Operable Unit 01 - Sediments; and Operable Unit 05 - Sources

**Lead and Support Agencies**

U.S. Environmental Protection Agency (EPA) - Lead Agency for Sediment Remediation
Washington State Department of Ecology (Ecology) - Lead Agency for Source Control; Support Agency for Sediment Remediation
Puyallup Tribe of Indians - Support Agency

**Statutory Authority**

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 117(c) and National Oil and Hazardous Substances Contingency Plan (NCP), Section 300.435(c)(2)(I).

**Purpose**

The purpose of this Explanation of Significant Differences (ESD) is to modify the cleanup level for remediation of marine sediments contaminated with polychlorinated biphenyls (PCBs) at the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site. EPA's September 30, 1989, Record of Decision (ROD) for the CB/NT Site established cleanup levels, called Sediment Quality Objectives (SQOs), for several problem chemicals found to be causing adverse effects to human health and the environment at the CB/NT Site. The SQO for PCBs was set at 150 $\mu$g/kg (micrograms per kilogram or parts per billion) dry weight (DW). The ROD required that the SQOs be met within ten years after completion of sediment remedial action. The ROD predicted that, if sediments with PCB concentrations greater than a Sediment Remedial Action Level (SRAL) of 240 - 300 $\mu$g/kg PCBs were removed, the 150 $\mu$g/kg PCB SQO would be met in 10 years through natural recovery processes. With this ESD, EPA is modifying the PCB SRAL to 450 $\mu$g/kg, to be achieved during cleanup, and the PCB SQO to 300 $\mu$g/kg, to be achieved within 10 years after cleanup.

EPA believes it is appropriate in some circumstances to make changes to existing decisions at Superfund sites to enhance overall remedy effectiveness and cost-effectiveness, as long as it does not compromise protectiveness or other objectives of the Superfund program. In this case, EPA decided to re-evaluate the PCB cleanup level for the CB/NT Site for the following reasons.

During pre-design sampling, new data were collected from the Hylebos Waterway showing that approximately twice the amount of sediment originally estimated in the ROD would require cleanup, and that cleanup costs would also be about twice the estimate in the ROD. In addition, EPA has updated the toxicity information it uses to assess human cancer risks associated with PCBs.

EPA's reevaluation of the PCB SQO at the CB/NT Site is described in a document entitled "Reevaluation of Residual Risks Associated with a Range of Sediment PCB Cleanup Levels in the Hylebos Waterway, Thea Foss Waterway, and Overall CB/NT Superfund Site" (Weston, 1997a) and in EPA's public review draft ESD (EPA, 1997). Based on EPA's reevaluation of the human health and environmental risks associated with PCBs, and through our evaluation using EPA's nine Superfund remedy selection criteria, EPA has determined that it is appropriate to modify the PCB cleanup level to 450 $\mu$g/kg, to be achieved during cleanup, and 300 $\mu$g/kg, to be achieved within 10 years after cleanup through natural recovery processes.

Cleanup to 450 $\mu$g/kg is expected to result in a post-cleanup average PCB concentration of less than 150 $\mu$g/kg in all waterways at the CB/NT Site. EPA estimates that the post-cleanup average PCB sediment concentration after cleanup to 450 $\mu$g/kg will be 75 $\mu$g/kg for the CB/NT Site, 124 $\mu$g/kg for the Hylebos Waterway, and 108 $\mu$g/kg for the Thea Foss Waterway. PCB sediment concentrations are expected to be further reduced over time due to natural recovery processes to approximately 63 $\mu$g/kg for the CB/NT Site, 80 $\mu$g/kg for the Hylebos Waterway, and 81 $\mu$g/kg for the Thea Foss Waterway.

**Administrative Record**

This ESD and other documents that EPA relied upon to make this decision are part of the Administrative Record for the CB/NT Superfund site, which is available to the public at the following locations:

U.S. Environmental Protection Agency
1200 6th Avenue, Records Center (7th floor)
Seattle, Washington 98101

Tacoma Public Library
Northwest Room
1102 Tacoma Avenue
Tacoma, Washington 98402

## II. BACKGROUND

### CB/NT ROD

The CB/NT Superfund site is located in Tacoma, Washington at the southern end of the main basin of Puget Sound. The site includes 10-12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The upland boundaries of the site are defined according to the contours of localized drainage basins that flow into the marine waters. The marine boundary of the site is limited to the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water level. The nearshore portion of the site is defined as the area along the Ruston shoreline from the mouth of Thea Foss Waterway to Pt. Defiance. The tideflats portion of the site includes the Hylebos, Blair, Sitcum, Milwaukee, St. Paul, Middle, Wheeler-Osgood, and Thea Foss Waterways; the Puyallup River upstream to the Interstate-5 bridge; and the adjacent land areas (EPA, 1989). (Although the Blair and St. Paul Waterways have been deleted from the CB/NT Site because cleanups in those waterways are complete, they were included in the human health and ecological risk reevaluation of the PCB cleanup level.)

The Commencement Bay site has been divided into smaller project activities, called operable units (OU), in order to more effectively manage the overall cleanup of the site. In a September 30, 1989 ROD, EPA designated two operable units for the cleanup of the nearshore/tideflats portion of Commencement Bay: source control (OU 5), which focuses on efforts to control upland discharges or releases to the Bay, and sediment remediation (OU 1), which addresses the cleanup of the contaminated marine sediments in Commencement Bay. The Washington Department of Ecology (Ecology) is the lead agency for source control and EPA is the lead agency for sediment remediation.

EPA placed the CB/NT Site on the National Priorities List (NPL) of sites requiring investigation and cleanup under EPA's Superfund Program on September 8, 1983. A remedial investigation/feasibility study (RI/FS) was completed by Ecology in 1988. The RI/FS concluded that sediments in the nearshore/tideflats area were contaminated with a large number of hazardous substances at concentrations greatly exceeding those found in Puget Sound reference areas. In the RI, a multi-step decision-making process was used to identify problem chemicals, and to identify and prioritize problem areas where these chemicals were present at concentrations which are harmful to humans and wildlife. Over 50 problem chemicals and nine high priority problem areas were identified by this process.

In the 1989 ROD, EPA selected a remedial action for eight of the nine sediment problem areas. These problem areas are: 1) Mouth of Hylebos Waterway, 2) Head of Hylebos Waterway, 3) Sitcum Waterway, 4) St. Paul Waterway, 5) Middle Waterway, 6) Head of Thea Foss (formerly City) Waterway, 7) Mouth of Thea Foss Waterway, and 8) Wheeler-Osgood Waterway. The ninth problem area off-shore of the Asarco smelter will be addressed in a separate ROD.

PCBs, along with a number of other chemicals, were identified as problem chemicals in the Mouth and Head of Hylebos Waterway problem areas. PCBs have been detected at concentrations as high as 24,000 $\mu$g/kg in the Hylebos Waterway. PCBs are also present in the Thea Foss Waterway problem areas, however, current information indicates that cleanup of other chemicals such as polynuclear aromatic hydrocarbons (PAHs) and metals will also encompass

PCB-contaminated areas. PCBs are not widely distributed in elevated concentrations in other CB/NT problem areas. -

The 1989 ROD describes a sediment remediation process which includes a combination of natural recovery and active sediment cleanup. For those areas in which modeling indicates that SQOs will not be achieved through natural recovery processes within ten years after sediment remediation, the ROD provides for confining and isolating the contaminated sediments by using one of four disposal options: in-place capping, dredging and confined aquatic disposal, dredging and nearshore disposal, or dredging and upland disposal. Natural recovery is the process whereby sediment concentrations in the upper sediment layers are reduced over time after source control and cleanup of highly contaminated sediments through mixing with and burial by more recently deposited clean sediments, as well as other natural processes such as biodegredation and diffusive loss to the water column. Other components of the selected remedial action for the eight CB/NT problem areas are: source control, site use restrictions, and long-term monitoring.

**1989 ROD Cleanup Goals**

The cleanup goal for the Commencement Bay problem areas is reduction of contaminant concentrations in sediments to levels that will support a healthy marine environment and will protect the health of people eating seafood from the Bay. The ROD designated biological test requirements and associated sediment chemical concentrations referred to as Sediment Quality Objectives (SQOs) in order to achieve this goal. The goal is established to allow a diverse range of uses in the bay including industrial, commercial, navigation, fisheries, and recreation.

SQOs for all problem chemicals were set based on an evaluation of the ecological and human health risks posed by these chemicals. The SQO for PCBs was based on the human health risk assessment. SQOs for all other chemicals were based on the ecological risk assessment, because the ecologically-based cleanup levels were determined to be also protective of human health.

<u>Ecological Risk-Based Cleanup Goals</u>

The chemical SQOs for protection of aquatic life were set using the Apparent Effects Threshold (AET) method. An AET is the sediment concentration of a chemical above which statistically significant biological effects are always observed in the test organism used to generate AET values. In other words, if any chemical exceeds its AET value for a particular biological indicator, then an adverse biological effect is predicted for that indicator. The three biological effects used to define the AET-derived SQOs were benthic infauna abundance, amphipod mortality, and oyster larvae abnormality. This method has subsequently been used, with some modifications, to develop the State of Washington's Sediment Management Standards (SMS - Chapter 173-204 WAC). The AET method predicted that a sediment PCB concentration of 1,000 $\mu$g/kg (dry weight) would be protective of aquatic life for the species tested. The AET method does not address bioaccumulation, and thus may underestimate risks to organisms who eat invertebrates or fish contaminated with bioaccumulative compounds like PCBs. It was determined that the SQO for PCBs should be set based on the risks to human health from eating PCB-contaminated seafood, because a lower PCB cleanup level was necessary to protect human health.

Human Health-Based Cleanup Goals

Human health risks from consumption of contaminated seafood at the CB/NT Site were evaluated in the 1988 RI/FS using chemical analysis of English sole (a bottom-dwelling flatfish) muscle tissue, English sole livers, and crab muscle tissue. Of the more than 100 chemicals analyzed, only PCBs were measured in seafood at concentrations significantly greater than background and sufficiently high to pose a potential threat to human health due to fish consumption. The risk assessment estimated a lifetime excess cancer risk of $6 \times 10^{-3}$, or 6 in 1,000, assuming that one pound of Commencement Bay fish are consumed each day. This means that, at most, a person has a 6 in 1,000 chance of getting cancer over his or her lifetime from eating one pound per day of fish with the PCB contaminant levels measured in Commencement Bay. A lifetime excess cancer risk of $2 \times 10^{-4}$, or 2 in 10,000, was estimated for a person eating one pound of Commencement Bay fish per month. The analysis focused on cancer risks as the most conservative estimate of risks to human health. The risk assessment estimated cancer risks only, because a PCB cleanup level based on cancer risks was shown to be protective of non-cancer related health risks as well.

These risks were estimated based on measured concentrations of total PCBs in fish. Maximum PCB concentrations in English sole muscle tissue were found in the Hylebos Waterway at 1,300 $\mu$g/kg (wet weight). English sole from the Hylebos Waterway had an average PCB concentration of 332 $\mu$g/kg, approximately ten times higher than the average concentration found in fish from the reference area at Carr Inlet (36 $\mu$g/kg). The CB/NT Site-wide average PCB concentration in English sole muscle tissue was 210 $\mu$g/kg.

Based on the human health risk assessment, a sediment SQO of 150 $\mu$g/kg (dry weight) total PCBs was set using the following method:

- An equilibrium partitioning approach was used to estimate that the PCB fish muscle tissue concentration of 36 $\mu$g/kg (wet weight) found in the Carr Inlet reference area would be associated with a sediment concentration of 30 $\mu$g/kg (dry weight) PCBs. A post-cleanup geometric mean sediment concentration of 30 $\mu$g/kg PCBs was set as a goal for the CB/NT Site.

- The overall post-cleanup sediment concentration was calculated based on the geometric mean of the post-cleanup data set assuming that PCB concentrations would be reduced to 20 $\mu$g/kg in all areas where PCB-contaminated sediments were remediated. It was determined that cleanup of areas with sediment PCB concentrations greater than 150 $\mu$g/kg would achieve an average post-cleanup residual PCB concentration of 30 $\mu$g/kg in sediments.

By this method, EPA calculated that a PCB SQO of 150 $\mu$g/kg would result in attainment of PCB concentrations in fish tissue similar to those in Puget Sound reference areas (36 $\mu$g/kg). The lifetime excess cancer risk associated with consumption of 12.3 grams of fish per day (approximately one pound per month) at the reference PCB concentration of 36 $\mu$g/kg was estimated to be 4 x $10^{-5}$. EPA's goal for Superfund cleanups is to reduce human health risks to within a range of $10^{-4}$ to $10^{-6}$ (or 1 in 10,000 to 1 in 1,000,000).

## III. DESCRIPTION OF AND BASIS FOR THE SIGNIFICANT DIFFERENCES

EPA started its reevaluation of the PCB SQO in 1996, by calculating the human health risks associated with PCBs remaining in sediments after cleanup to potential sediment cleanup levels ranging from 50 $\mu$g/kg to 900 $\mu$g/kg PCBs. That analysis used the risk assessment assumptions and equation used in the 1989 ROD, and updated it with current sediment quality data (Weston, 1996). This report was sent to several parties for review, and EPA received 20 comment letters. Many of the commentors asked EPA to update the risk assessment using current methods and assumptions. Several commentors also asked EPA to address ecological risks in its updated risk evaluation. The National Oceanic and Atmospheric Administration (NOAA) and the U. S. Fish and Wildlife Service (FWS) provided information on recent studies showing effects of PCBs on wildlife, as well as site-specific studies in the Hylebos Waterway. Based on these comments, EPA updated the ecological and human health risk evaluations (Weston 1997a), as discussed below.

In its analysis, EPA evaluated human health and ecological risks remaining immediately after cleanup, and in ten years after cleanup. EPA compared potential PCB cleanup levels to the PCB SRAL in the 1989 ROD of approximately 300 $\mu$g/kg. Reduction in risk over time due to natural recovery is also discussed. Because PCBs remain in tissues for a long time after exposure, it is important that exposure to PCBs in sediments is reduced immediately after cleanup, as well as in the long term.

The area evaluated for both the human health and ecological risk evaluations is the marine portions of the CB/NT Site as it is defined in the 1989 ROD. This includes the seven waterways at the southeast corner of Commencement Bay, and the shoreline, intertidal areas, bottom sediments, and water of depths less than 60 feet below mean lower low water level. The area considered in the risk evaluations in shown in Figure 1. Because there are no known sources of PCB contamination in Commencement Bay outside of the CB/NT Site, exposure to PCBs by people who fish and marine organisms which utilize other areas of Commencement Bay will be lower than estimated here.

### Ecological Risk Evaluation

Several reviewers to the revised human health evaluation pointed out that EPA should reevaluate the ecological effects associated with a variety of potential cleanup levels using new information developed since the ROD was signed. To address ecological concerns, EPA used information provided by NOAA, FWS, and other sources to evaluate potential threats to wildlife, including invertebrates, fish, and piscivorous (fish-eating) birds, at a range of PCB sediment cleanup levels. A summary of the analysis (Weston, 1997a) is provided below.

Invertebrates

The 1989 ROD indicated that a 1,000 $\mu$g/kg PCB sediment cleanup level would be protective of aquatic invertebrates based on the AET approach, using direct measurements of benthic community abundance in Commencement Bay and in other areas in Puget Sound. Ecology subsequently used the AET approach as part of its Sediment Management Standards (SMS) to set a total organic carbon-normalized minor adverse effects level of 65 mg PCBs/kg carbon based on benthic infauna abundance, equivalent to EPA's 1,000 $\mu$g/kg (dry weight or DW). Ecology also set a no adverse effects level for PCBs equivalent to 130 $\mu$g/kg (DW), based on the Microtox™ test. In addition, a variety of effects levels indices have been developed by other agencies based on compilations of nationally collected data, for example, NOAA's effects range-median (ER-M) of 180 $\mu$g/kg (DW) PCBs. These indices, for the most part, fall within the range set by Ecology's no adverse effects and minor adverse effects levels (130 to 1,000 $\mu$g/kg PCBs).

Fishes

In 1994 and 1995, the NOAA National Marine Fisheries Service conducted a series of investigations on behalf of Commencement Bay Natural Resource Trustees to determine contaminant exposure and associated injuries to Hylebos Waterway fish. NOAA measured juvenile salmonid and adult English sole exposure to toxic chemicals in Hylebos Waterway sediments, and potentially associated effects on English sole, including impaired growth, mortality, reduced disease resistance, and reproductive dysfunction.

These studies found that juvenile salmon have been exposed to a wide variety of contaminants, including PCBs, as compared to fish from hatcheries or reference areas. The levels of PCBs in juvenile salmonids from the Hylebos Waterway were found to be similar to levels shown in previous studies to be associated with injuries (e.g., reduced growth, increased mortality).

English sole within Hylebos Waterway were also found to be exposed to PCBs and other compounds and exhibited both liver lesions and reproductive dysfunction. There has been little change over the last 10 years in indicators of fish health, such as liver lesions. NOAA's studies showed precocious sexual maturation in adult females and inhibited gonadal development in adult males. Increased incidence of early onset of sexual maturation appears to be most closely associated with exposure to PCBs. The NOAA studies have not identified an effects threshold concentration in either fish tissue or sediment which could be used to set a protective PCB cleanup level.

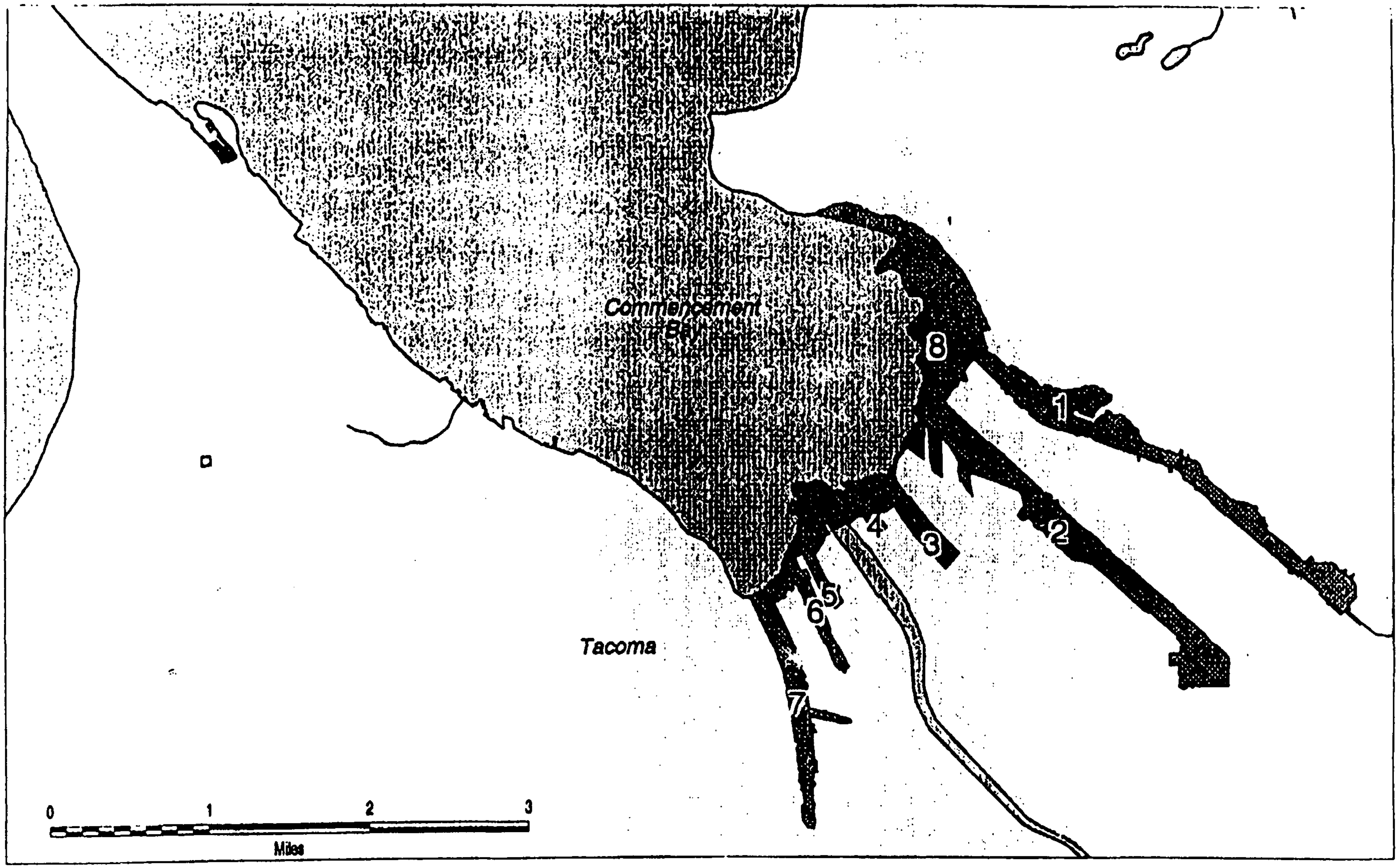


**Figure 1**

## Commencement Bay

**Areas Considered in Human Health and Ecological Risk Evaluation**

*Waterways:*

1 Hylebos Waterway
2 Blair Waterway
3 Sitcum Waterway
4 Milwaukee Waterway
5 St. Paul Waterway
6 Middle Waterway
7 Thea Foss/Wheeler-Osgood
8 Nearshore Area

EPA

EPA calculated a no adverse effects level for salmon based on information showing that in the Duwamish River, hatchery salmon had statistically significantly lower growth, higher mortality, and lower body burdens of PCBs (about 137 μg/kg) than fish exposed to sediments and prey within the river. A protective sediment concentration can be calculated for Commencement Bay to be about 83 μg/kg PCBs as a sediment concentration that would not result in adverse effects to juvenile salmonids.

Because fish and birds obtain their prey from more than one location, it is appropriate to compare effects levels to average sediment concentrations that will be achieved as a result of cleanup, rather than the cleanup levels themselves. By dividing the estimated effects level by the post-cleanup average PCB concentration (as shown on Table A-1), a hazard quotient (HQ) can be calculated. An HQ which is less than 1 indicates a low potential for adverse effects. The estimated HQ for Commencement Bay and the individual waterways is shown in Table 1. As shown in Table 1, at the 300 μg/kg PCB SQO, the HQs for juvenile salmonids at the CB/NT Site, and the Hylebos and Thea Foss Waterways are all less than 1. At the 450 μg/kg PCB SRAL, the estimated HQ for juvenile salmonids are less than or equal to 1 for the CB/NT Site and the Hylebos and Thea Foss Waterways.

Table 1. Hazard Quotients for juvenile salmonids based on the 150 μg/kg SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

| Organism | Cleanup level (μg/kg) | Hazard Quotient | | |
|---|---|---|---|---|
| | | CB/NT Site | Hylebos Waterway | Thea Foss Waterway |
| Juvenile Salmonids | 150 | < 1 | < 1 | < 1 |
| | 300 | < 1 | < 1 | < 1 |
| | 450 | < 1 | 1 | < 1 |

Note: HQ for the CB/NT Site assumes fish obtain 100% of their diet from the CB/NT Site. HQ for the individual waterways assume fish obtain 100% of their diet from that waterway.

Birds

For its analysis of potential effects of PCB-contaminated sediments on birds, EPA drew upon a FWS assessment of the potential for injury based on calculation of a hazard quotient or ratio between the predicted egg concentration and an egg concentration reported in the literature to be associated with significant ecological impacts, such as embryonic deformity and egg lethality. The amount of sediment transfer from sediments to fish, from fish to birds and subsequently to bird eggs, was estimated using information from EPA and FWS studies on transfer of PCBs and dioxins between predators and prey.

Hazard quotients were calculated for shorebirds and piscivorous (fish eating) birds by dividing the estimated sediment concentrations above which adverse effects to bird eggs are predicted to occur under the assumptions in the risk assessment by the post-cleanup average sediment PCB concentration. These results are shown in Table 2. Table 2 shows HQs of less than or equal to 1 for shorebirds and piscivorous birds at the 300 μg/kg PCB SQO. At the 450 μg/kg PCB SRAL, HQs for shorebirds and piscivorous birds are at 2 or below.

Table 2. Hazard Quotients for shorebirds and piscivorous birds, based on the 150 μg/kg SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

| Organism | Cleanup level (μg/kg) | Hazard Quotient | | |
|---|---|---|---|---|
| | | CB/NT Site | Hylebos Waterway | Thea Foss Waterway |
| Shorebirds | 150 | < 1 | < 1 | < 1 |
| | 300 | < 1 | < 1 | < 1 |
| | 450 | 1 | 1 | < 1 |
| Piscivorous Birds | 150 | 1 | < 1 | < 1 |
| | 300 | 1 | 1 | < 1 |
| | 450 | 2 | 2 | 1 |

Note: HQ for the CB/NT Site assumes birds obtain 100% of their diet from the CB/NT Site. HQ for the individual waterways assume birds obtain 100% of their diet from that waterway.

Uncertainties

The estimates of potential risk to invertebrates, fish, and birds incorporate a number of assumptions, all of which have uncertainties associated with them. Examples of uncertainties and their effect on the resulting risk estimates are discussed below.

Although the AET database used to estimate risks to invertebrates was developed using Commencement Bay data, along with data from other areas in Puget Sound, recent biological data collected for the Hylebos Waterway indicate that the AET database may have overestimated the chemical concentration at which impacts were expected to occur.

For birds, the biomagnification factor (an estimate of contaminant transfer between predators and prey) was developed based on empirical data on alewives and herring gull in the Great Lakes. The accuracy of this estimate when applied to other species, especially species higher on the food chain, is uncertain.

The calculation of a protective sediment concentration for juvenile salmonids is uncertain because of the extrapolation of Duwamish estuary data to Commencement Bay and application of a biota-sediment accumulation factor (an estimate of the transfer of contaminants from sediments to organisms) developed for bottom fish to a water column species. Use of these data and associated assumptions may either over- or underestimate risks to juvenile salmonids, and should not be extrapolated to other types of fish.

The estimated HQs for fish and birds assume that they obtain all of their food from within the CB/NT Site. The actual foraging habits and foraging range of fish and birds varies by species and in many cases, by season. The assumption used in the ecological risk evaluation will overestimate the exposure of species or individuals with large foraging ranges (such as migratory birds) but the CB/NT Site-wide risk estimate may underestimate the exposure of resident species that preferentially feed at a specific location.

Summary of Ecological Risk Evaluation

In summary, the updated ecological risk analysis showed that the 300 μg/kg PCB SQO and 450 μg/kg PCB SRAL is protective of the benthic community, juvenile salmonids, shorebirds and piscivorous birds. Cleanup to the 300 μg/kg PCB SQO will reduce all HQs estimated for these species to 1 or below.

**Human Health Risk Evaluation**

Exposure Assumptions

EPA updated the human health risk evaluation and used it as a basis to evaluate the risks associated with a variety of potential PCB cleanup levels in a February 1997 report (Weston, 1997a). Although EPA's risk assessment methodology has not been modified substantially since the original risk assessment was performed in 1988, some of the exposure and toxicity assumptions have been changed based on new information and new Superfund guidance.

As with the 1989 ROD, the updated risk evaluation focused on risks due to consumption of PCB-contaminated seafood. The National Contingency Plan (40 CFR Part 300) calls for EPA to use a reasonable maximum exposure (or "high-end") scenario for making Superfund cleanup decisions. EPA also recommends calculating an average exposure scenario for comparison purposes. Four scenarios were used in the updated risk evaluation: average recreational fishing, "high-end" recreational fishing, average tribal fishing, and "high-end" tribal fishing.

Because the Puyallup Tribe of Indians has treaty rights to fish in Commencement Bay, high-end tribal fishing was used as the reasonable maximum exposure scenario for EPA's decision-making purposes. An average and high-end recreational fishing scenario and an average tribal fishing scenario were also calculated for purposes of comparison. Fish consumption rates for the recreational fishing scenario are the same as used in the 1989 ROD. Because no studies have documented tribal fish consumption rates in Commencement Bay, they were estimated from recently completed surveys of fish consumption by members of two other Puget Sound Indian tribes, the Tulalip and Squaxin Island Tribes (Toy et al., 1996). The high-end tribal scenario represents risks to a tribal fisherperson who consumes a relatively large amount (upper 90th percentile) of fish compared to other tribal members.

A summary of the fish ingestion rates assumed for each of the four scenarios used in the updated residual risk evaluation and the scenario used in the ROD risk evaluation is presented in Table 3. Information about all of the assumptions used in the risk assessment, and modifications made to update the original risk assessment, is provided in Weston (1997a) and Appendix A.

Table 3: Fish ingestion rates used in the updated residual risk evaluation, and in the CB/NT ROD.

| Scenario | Fish Ingestion Rate (1) | Basis |
|---|---|---|
| High-end Tribal Fishing | 123 g/day (approx. 20 meals/month) | Tulalip/Squaxin Island Fish Consumption Survey (Toy et al., 1996) |
| Average Tribal Fishing | 41.7 g/day (approx. 7 meals/month) | Tulalip/Squaxin Island Fish Consumption Survey (Toy et al., 1996) |
| High-end Recreational Fishing | 95.1 g/day (approx. 15 meals/month) | CB/NT ROD (1989) |
| Average Recreational Fishing | 12.3 g/day (approx. 2 meals/month) | CB/NT ROD (1989) |
| CB/NT ROD | 12.3 g/day (approx. 2 meals/month) | A combination four recreational fishing surveys, as summarized in Tetra Tech, 1988 |

(1) One half pound of fish per meal was used to calculate meals/month.

Cancer Risks

Post-cleanup residual cancer risks were calculated for a range of potential PCB sediment cleanup levels from 50 $\mu$g/kg to 900 $\mu$g/kg. Results for the high-end tribal fishing scenario at the former PCB SQO of 150 $\mu$g/kg and the current 300 $\mu$g/kg PCB SQO and 450 $\mu$g/kg SRAL are shown in Table 4. Cleanup to all of these cleanup levels will result in substantial risk reduction over current conditions. The residual human health cancer risks for the high-end recreational fishing scenario were similar to results for the high-end tribal fishing scenario, and results for the average recreational and average tribal fishing scenarios are three to ten times lower than for either of the high-end scenarios. For comparison, human health cancer risks from fish consumption at Puget Sound background conditions in non-industrial areas under the high-end tribal fishing scenario is $6 \times 10^{-5}$ (Weston 1997c). Additional information about the results of the risk evaluation is presented in Appendix A.

Table 4. Post-cleanup residual cancer risk (using the high-end tribal fishing scenario) based on the 150 $\mu$g/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 $\mu$g/kg and SRAL of 450 $\mu$g/kg.

| PCB Cleanup level ($\mu$g/kg) | Estimated post-cleanup residual cancer risk under the high-end tribal fishing scenario | | |
|---|---|---|---|
| | CB/NT Site | Hylebos Waterway | Thea Foss Waterway |
| Current Conditions (no cleanup) | $9.8 \times 10^{-4}$ | $1.1 \times 10^{-3}$ | $1.7 \times 10^{-4}$ |
| 150 | $9.4 \times 10^{-5}$ | $4.9 \times 10^{-5}$ | $4.6 \times 10^{-5}$ |
| 300 | $1.2 \times 10^{-4}$ | $1.1 \times 10^{-4}$ | $7.6 \times 10^{-5}$ |
| 450 | $1.4 \times 10^{-4}$ | $1.6 \times 10^{-4}$ | $1.0 \times 10^{-4}$ |

As shown in Table 4, the estimated post-cleanup cancer risks at the 300 $\mu$g/kg PCB SQO are within EPA's acceptable risk range of $10^{-4}$ to $10^{-6}$. Cleanup to the 450 $\mu$g/kg PCB SRAL will result in interim risks that are also within EPA's acceptable risk range. Although the estimated risk is $1.4 \times 10^{-4}$ for the CB/NT Site and $1.6 \times 10^{-4}$ for the Hylebos Waterway, EPA policy states that the upper boundary of the risk range is not a discrete line at $1 \times 10^{-4}$. Cleanups to levels slightly greater than $1 \times 10^{-4}$ may be considered acceptable if justified based on site-specific conditions. People are more likely to fish in more than one location in Commencement Bay than in Hylebos Waterway alone, so the CB/NT Site-wide risk estimate is the best estimate of risks to area fisherpersons.

These cancer risk estimates are based on a number of assumptions, all of which have uncertainties associated with them. For example, although studies suggest that exposure to PCBs increases cancer risk in humans, EPA's cancer slope factor (an estimate of the potency of PCBs to cause cancer) is derived mainly from studies on laboratory animals. Similarly, estimates of the transfer of PCBs from sediments to fish and from fish to humans, the amount and type of fish consumed by individuals in the area, and many other factors make it difficult to estimate an individual's exposure to PCBs from eating fish from Commencement Bay. Although the risk numbers in Table 4 and Appendix A are estimates that have many uncertainties associated with them, they were derived in a manner to ensure they are protective of health and are unlikely to underestimate actual risks to fish consumers.

Non-cancer risks

In the human health risk assessment done for the CB/NT Site in 1985, the potential for both cancer and non-cancer health effects from exposures to PCBs in fish from the CB/NT Site was evaluated. Based on the information available on the toxicity of PCBs at that time, it was concluded that the potential for non-cancer impacts was not of concern. Therefore, when the

ROD was written in 1989, EPA based its cleanup level for PCBs on human health cancer risks from ingestion of PCB-contaminated fish caught in the Bay.

Similarly, in the updated risk evaluations (Weston 1996, 1997a) and in EPA's public review draft ESD (EPA, 1997), EPA focused on cancer risks associated with PCBs, and updated non-cancer risk information was not presented in these reports. In response to public comments, EPA has prepared a technical memorandum which provides information regarding non-cancer risks under current and post-cleanup conditions using the scenarios developed for the cancer risk evaluation. This technical memorandum (Weston, 1997b) has been added to the Administrative Record for our final decision. A summary is provided below.

Based upon an understanding of the development of non-cancer health effects, potential non-cancer impacts are evaluated by EPA assuming that there is a level of exposure below which health impacts are unlikely to occur. The estimate of this level of exposure is called the reference dose, or RfD, and is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." Exposures that are less than the RfD are not likely to be associated with adverse health impacts.

In order to calculate non-cancer risks for site-specific risk assessments, EPA compares the RfD to the exposures estimated for that site (e.g., from eating contaminated fish). This comparison, called the Hazard Quotient or HQ, is the ratio between the estimated site exposure and the RfD. As with cancer risk, the assumptions used in calculating the HQ are conservative ones (health protective) to ensure that remedial decisions based upon them will protect more sensitive individuals. Because of the way in which the HQ is derived, it should not, however, be viewed as a strict demarcation between toxic and nontoxic. HQ values above 1 do not mean that non-cancer health impacts will occur, but rather that the potential for such impacts increases as 1 is exceeded. The potential for impacts depends on a number of factors, including the protectiveness of both the RfD and the exposure assumptions used to calculate the HQ. The derivation of the RfD for PCBs is based upon a large body of experimental data and incorporates a several hundred fold uncertainty factor ("safety" factor) to ensure protection.

Results of this non-cancer risk evaluation are shown in Tables 5 and 6. Both the cleanup required under the 1989 ROD and in this ESD provide for substantial reduction in the non-cancer risks associated with PCBs in sediments at the CB/NT Site. As with cancer risks, the residual human health non-cancer risks for the high-end recreational fishing scenario were similar to results for the high-end tribal fishing scenario, and results for the average recreational and average tribal fishing scenarios are three to ten times lower than for either of the high-end scenarios. For comparison, the human health hazard quotient for non-cancer risks due to PCBs from fish consumption at Puget Sound background conditions in non-industrial areas under the "high-end" tribal fishing scenario is 3 (Weston, 1997c). As with cancer risks, given the range of uncertainty in risk calculations, these post-cleanup HQs are not significantly different. Also, the exposure assumptions used in the CB/NT risk evaluation were selected to be protective for a consumer of large amounts of fish from the CB/NT Site over a 30-year period. Given these conservative assumptions, the small increases above an HQ of 1 estimated for the various target cleanup levels and for background suggest a low potential for non-cancer impacts for the fish consumers considered in the calculations. Individuals who eat less fish from the CB/NT Site will have exposures and HQs that are lower and, therefore, their potential for non-cancer impacts will be less. Therefore, EPA does not believe that the 300 μg/kg PCB SQO provides significantly different non-cancer risks than the PCB cleanup level in the 1989 ROD.

Table 5. Post-cleanup residual non-cancer risk (using the high-end tribal fishing scenario) based on the 150 μg/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

| PCB Cleanup level (μg/kg) | Estimated post-cleanup residual non-cancer risk under the high end tribal fishing scenario | | |
|---|---|---|---|
| | CB/NT Site | Hylebos Waterway | Thea Foss Waterway |
| Current Conditions (no cleanup) | 60 | 60 | 10 |
| 150 | 6 | 3 | 3 |
| 300 | 7 | 6 | 4 |
| 450 | 8 | 9 | 6 |

Table 6. Post-cleanup residual non-cancer risk (using the average tribal fishing scenario) based on the 150 μg/kg PCB SQO in the 1989 ROD and the revised PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

| PCB Cleanup level (μg/kg) | Estimated post-cleanup residual non-cancer risk under the average tribal fishing scenario | | |
|---|---|---|---|
| | CB/NT Site | Hylebos Waterway | Thea Foss Waterway |
| 150 | 2 | 1 | 1 |
| 300 | 2 | 2 | 2 |
| 450 | 3 | 3 | 2 |

**Summary of Significant Differences**

Based on the information received and developed by EPA, this ESD modifies the PCB SQO for the CB/NT Site to 300 μg/kg, to be achieved within 10 years after remediation; and the PCB

SRAL to 450 $\mu$g/kg, to be achieved during cleanup. EPA used the nine remedy selection criteria contained in the NCP and listed below to evaluate and select the revised PCB cleanup level. Based on our analysis, EPA has determined that a PCB SQO of 300 $\mu$g/kg and SRAL of 450 $\mu$g/kg achieves the best balance of the nine evaluation criteria. Table 7 compares the PCB cleanup level in the 1989 ROD to the new cleanup levels.

Table 7. Comparison of post-cleanup maximum and average PCB concentration under the PCB cleanup level in 1989 ROD to the PCB cleanup level in this ESD.

| | 1989 ROD | | 1997 ESD | |
|---|---|---|---|---|
| | Immediately after cleanup ($\mu$g/kg) | Within 10 years after cleanup ($\mu$g/kg) (1) | Immediately after cleanup ($\mu$g/kg) | Within 10 years after cleanup ($\mu$g/kg) |
| CB/NT Site | 300 max/63 avg | 150 max/51 avg | 450 max/75 avg | 300 max/63 avg |
| Hylebos Waterway | 300 max/80 avg | 150 max/37 avg | 450 max/124 avg | 300 max/80 avg |
| Thea Foss Waterway | 300 max/81 avg | 150 max/49 avg | 450 max/108 avg | 300 max/81 avg |

(1) The 1989 ROD calculated a 36 $\mu$g/kg post-cleanup geometric mean for the CB/NT Site at the 150 $\mu$g/kg SQO. The averages shown here are arithmetic means.

The 1989 ROD set numerical SQOs for a number of chemicals, to be achieved within 10 years after cleanup. SRALs, or the cleanup levels to be met at the time of cleanup, are estimated in the 1989 ROD, but were to be established based on natural recovery modeling efforts during the design phase. Based on the information developed and comments received during the reevaluation of the PCB cleanup level, EPA is establishing with this ESD the maximum SRAL as well as the SQO for the CB/NT Site. Even if natural recovery modeling shows that some areas with a higher PCB concentration will naturally recover to 300 $\mu$g/kg in 10 years, in accordance with this ESD, areas with PCB concentrations of 450 $\mu$g/kg or higher will still be remediated.

EPA is making this modification because it considers 450 $\mu$g/kg to be the highest concentration of PCBs which should be allowed in CB/NT Site sediments after cleanup. The 450 $\mu$g/kg PCB SRAL is at the high end of the range EPA considers to be protective of human health and the environment. Because PCBs remain in the body for several years after uptake, any short-term exposure in the 10 years to achieve the SQO could have long-term effects to those exposed during that period. Therefore, a 450 $\mu$g/kg minimum PCB cleanup level will be required under all circumstances at the time of cleanup. If natural recovery modeling shows that a cleanup level lower than 450 $\mu$g/kg is necessary in some areas to achieve the 300 $\mu$g/kg SQO in 10 years, a lower cleanup level will be implemented. Based on natural recovery modeling done to date, EPA anticipates that this might occur in only a few, if any, locations. This approach is consistent with the 1989 ROD, which states that natural recovery is expected to be effective in marginally contaminated portions of the problem areas, but is not intended to address severe levels of contamination.

In the public review draft ESD, EPA's proposal was to require that PCB-contaminated sediments be cleaned up to 450 μg/kg PCBs, with no further natural recovery requirements. EPA's final decision is to add a natural recovery component to achieve 300 μg/kg PCBs in sediments within 10 years after remedial action. EPA believes this change is appropriate for two reasons:

1) EPA's original proposal relied on estimates of additional natural recovery to ensure protectiveness. Setting a long-term SQO, however, ensures that natural recovery modeling and monitoring will occur to verify these reductions in PCB concentrations over time, and that additional cleanup work will be implemented to achieve 300 μg/kg PCBs if sediments do not naturally recover to this level within 10 years.

2) Although dredging to 300 μg/kg PCBs would be unreasonably costly for the relatively small risk reduction achieved, costs associated with natural recovery to 300 μg/kg are relatively small and do not outweigh the benefits of additional risk reduction.

Natural recovery models done for the 1989 ROD indicate that PCB concentrations should be reduced to less than 300 μg/kg within 10 years after cleanup to 450 μg/kg. The cost of long-term monitoring in the natural recovery areas is estimated at $310,000. The cost of additional modeling is negligible given that modeling work is already being done to predict natural recovery rates of other chemicals. Even if the models have not accurately predicted the rate of natural recovery, and additional cleanup is needed ten years after cleanup, it is anticipated that cost-effective methods can be used to remediate sediments with contaminant concentrations between 300 and 450 μg/kg PCBs.

EPA's Nine Evaluation Criteria

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with applicable, or relevant and appropriate, regulations (ARARs)

Primary Balancing Criteria

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria

- State and Tribal acceptance
- Community acceptance

The 1989 ROD evaluated cleanup alternatives against the nine CERCLA evaluation criteria. In this section, these criteria are discussed only to the extent that they would be affected by the change in the PCB cleanup level. Because a modification to the PCB cleanup level will significantly affect only the Hylebos Waterway cleanup, the analyses of cost and implementability focus mainly on the Hylebos Waterway. In this analysis the 450 μg/kg PCB SRAL is compared to the 1989 ROD SRAL of approximately 300 μg/kg, and the 300 μg/kg PCB SQO is compared to the 150 μg/kg PCB SQO in the 1989 ROD. Other potential cleanup levels are also discussed.

Overall Protection of Human Health and the Environment

The NCP states that for chemicals which are known to cause cancer, cleanup levels should be selected within a cancer risk range of $10^{-4}$ to $10^{-6}$. Within that range, the NCP calls for EPA to select a cleanup goal which achieves the best balance of the remaining remedy selection criteria, with a preference for selecting cleanup goals that approach $10^{-6}$ where possible.

As shown in Table A-4, the human health risk evaluation for the CB/NT Site showed that all of the potential cleanup levels evaluated, from 50 μg/kg PCBs to 900 μg/kg PCBs, would result in post-cleanup residual cancer risks within EPA's risk range of $10^{-4}$ to $10^{-6}$. Lower PCB cleanup levels provide more protectiveness, and calculated residual risks are closer to EPA's "point of departure" of $10^{-6}$. Higher cleanup levels are at the less protective end of the range. As shown in Table A-4, there is very little difference in residual human health cancer risks between the ROD PCB SQO of 150 μg/kg and the revised SQO of 300 μg/kg set by this ESD. Both will result in human health cancer risks for the CB/NT Site of approximately $1 \times 10^{-4}$. As shown in Table 7, average sediment PCB concentrations after cleanup to the 450 μg/kg SRAL will be reduced to well below 150 μg/kg and will be further reduced over time to approximately 63 μg/kg within 10 years after cleanup.

The NCP does not set a numeric target range for non-cancer risks, but states that acceptable exposure levels shall represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Cleanup to 300 μg/kg PCBs will result in a CB/NT Site-wide HQ of 7. The HQ of 7 is not appreciably different than the HQ of 6 estimated for cleanup to 150 μg/kg PCBs under the 1989 ROD. Although EPA generally attempts to achieve a HQ of 1 or below in Superfund cleanups, in this case the HQ is greater than 1 even under background conditions. Because of the conservative assumptions built into the risk assessment and into the reference dose used to calculate the HQ, EPA believes that cleanup to 300 μg/kg PCBs is protective of non-cancer risks.

The ecological evaluation also shows that lower cleanup levels are associated with increased protection to wildlife. EPA's analysis estimates that a PCB SQO of 300 μg/kg and SRAL of 450 μg/kg will be protective of ecological receptors. Both values are below the 1,000 μg/kg PCB AET calculated in the CB/NT ROD as being protective of benthic infauna. Both values also fall between Ecology's minor adverse effects level (equivalent to 1,000 μg/kg dry weight) and no adverse effects level (equivalent to 130 μg/kg dry weight) as promulgated under the State's

Sediment Management Standards to protect aquatic life. The updated ecological risk analysis for fish, shorebirds, and piscivorous birds estimates a HQ of less than or equal to 2 immediately after cleanup and less than or equal to 1 within 10 years after cleanup.

The risk evaluation shows that cleanup to EPA's revised SQO of 300 $\mu$g/kg PCBs and SRAL of 450 $\mu$g/kg PCBs will result in a substantial reduction in risk to human health and the environment due to PCBs at the CB/NT Site. They will reduce cancer risks to within EPA's acceptable risk range, and will be protective of non-cancer risks and wildlife.

Compliance with ARARs

There are no federal or state regulations that provide human-health based PCB cleanup levels for sediments. Since publication of the ROD, the State of Washington has promulgated Sediment Management Standards (SMS), which require that contaminant levels in sediments within the State be protective of human health and aquatic life. The SMS contains numeric chemical criteria for protection of aquatic life (Chapter 173-204 WAC). The SMS also requires that sediment cleanups be protective of human health, and states that Ecology will determine sediment criteria which are protective of human health on a case by case basis, but contains no numeric standards for human health protection.

The CB/NT ROD and the Washington State SMS share the same narrative goal of the absence of acute or chronic adverse effects on biological resources or significant human health risk. They also share the use of the AET process (as described in the 1989 ROD, with some modifications introduced into the State SMS) to select chemical sediment criteria for protection of aquatic life.

The NCP provides that a promulgated state environmental requirement is an ARAR if it is more stringent than cleanup levels developed by EPA as a result of the human health and ecological risk assessments. The NCP also states that state environmental standards promulgated after the signing of a ROD must be attained only if they are applicable, or relevant and appropriate, and necessary to ensure protectiveness. EPA evaluated the State SMS requirements for ecological and human health-based cleanup levels and determined that it was not more stringent than the evaluation process EPA used to select a PCB cleanup level, nor was application of the State SMS requirements necessary to ensure protectiveness.

Long-term Effectiveness and Permanence

Under this criterion, EPA evaluates the magnitude of residual risk after cleanup, and the adequacy and reliability of long-term controls. As discussed under the "protection of human health and the environment" section, cleanup to the 450 $\mu$g/kg SRAL and natural recovery to the 300 $\mu$g/kg SQO, rather than the 1989 ROD SRAL of 300 $\mu$g/kg and SQO of 150 $\mu$g/kg, will result in a slightly higher residual risk after cleanup. CB/NT Site-wide estimated residual cancer risks due to PCBs for the 1989 SQO of 150 $\mu$g/kg PCBs are $9.4 \times 10^{-5}$ versus $1.2 \times 10^{-4}$ for the 300 $\mu$g/kg SQO under this ESD. For Hylebos Waterway, estimated residual cancer risks for the former 150 $\mu$g/kg PCB SQO are $4.9 \times 10^{-5}$ versus $1.1 \times 10^{-4}$ for the 300 $\mu$g/kg SQO under this ESD. Similarly, the non-cancer HQ for the CB/NT Site is 6 under the 1989 ROD SQO and 7 under the revised SQO.

Average post-cleanup PCB concentrations will be reduced to less than 150 $\mu$g/kg immediately after cleanup, and will be reduced further over time through natural recovery processes. As shown in Table 7, PCB concentrations will be reduced to a maximum of 300 $\mu$g/kg and an average of 63 $\mu$g/kg PCBs in 10 years.

For cleanup to the PCB cleanup levels in the 1989 ROD and this ESD, tested and reliable technologies exist for containing sediments and preventing contaminant migration in the long term. As discussed below, a greatly increased volume of PCB-contaminated sediments would require containment under the current ROD, as compared to the PCB cleanup required under this ESD. By reducing the volume of sediments that require confinement, a smaller disposal site (or fewer disposal sites) will be required. This will reduce the cost and complexity of long-term monitoring and engineering controls to ensure the protectiveness of confined disposal.

Reduction of toxicity, mobility and volume through treatment

This criterion is unaffected by the range of alternatives evaluated for a modified PCB sediment cleanup level because the cleanup plan for contaminated sediments under the 1989 ROD does not involve treatment.

Short-term effectiveness

The analysis of short-term effectiveness remains the same as presented in the original ROD, except to note that changing the SRAL from 300 to 450 $\mu$g/kg PCBs decreases the volume of sediments requiring remediation by approximately 400,000 cubic yards. This in turn decreases the short term disruption to aquatic organisms living in the sediments during remediation. Approximately twice as much of the surface area of the Hylebos Waterway would have been disrupted through dredging or capping at the 300 $\mu$g/kg PCB SRAL than at 450 $\mu$g/kg. For all cleanup volumes, a monitoring program will be implemented and measures will be taken to control releases of contaminated sediments to the water column.

Implementability

Cleanup of contaminated sediments under the PCB cleanup levels in the 1989 ROD and this ESD is technically feasible. However, due to the limited number and capacity of disposal sites in Commencement Bay, the larger the volume of sediments to be remediated, the greater the difficulty in selecting a suitable disposal site or sites. Also, at higher cleanup volumes, multiple disposal sites would be needed for the Hylebos Waterway cleanup, in addition to sites required for other waterway cleanups, which will increase the cost, as well as technical and administrative difficulties, associated with implementing the remedy. Because remediation to the 300 $\mu$g/kg

PCB SRAL under the 1989 ROD requires remediation of appproximately 400,000 cubic yards more sediments than remediation to the 450 $\mu g/kg$ SRAL required under this ESD, EPA's current proposal is more technically and administratively feasible than cleanup to the former SRAL.

Cost

Because the volume of sediments requiring remediation in CB/NT problem areas other than the Hylebos Waterway is largely unaffected by the PCB cleanup level, the cost analysis presented here is focused on the Hylebos Waterway. The ROD estimated that 1,167,000 cy of Hylebos Waterway sediments are contaminated at concentrations exceeding the ROD SQOs. The ROD estimated that a cleanup of 447,000 cy of contaminated sediments would allow the Waterway to recover to meet SQOs for all chemical contaminants in 10 years. The ROD estimated a cost of $13,850,000 for cleanup of Hylebos Waterway sediments using confined aquatic disposal, and that costs would be higher for upland disposal and lower for other disposal options.

Table 8 shows the volume of sediments requiring remediation and estimated cleanup costs for the Hylebos Waterway, based on current information. As shown in Table 8, the estimated cost to achieve the 150 $\mu g/kg$ PCB cleanup level in 10 years (assuming an SRAL of 300 $\mu g/kg$) has more than doubled since the ROD estimated $13 million.

Table 8. Estimated sediment cleanup volumes for the Hylebos Waterway and associated cost of remediation at a range of PCB cleanup levels.

| PCB Sediment Remedial Action Level ($\mu g/kg$) | Cleanup Volume (PCB-contaminated sediments only) (cy)(1) | Cleanup Volume (cleanup of all contaminated sediments) (cy) (1) | Estimated Cleanup Cost (for all contaminated sediments) (millions) (2) |
|---|---|---|---|
| 150 | 1,115,700 | 1,339,000 | $46.5 (3) |
| 300 | 559,721 | 891,000 | $31(3) |
| 450 | 246,565 | 508,000 | $18 |
| 600 | 149,444 | 436,000 | $15.5 |
| 750 | 107,206 | 409,000 | $14.5 |
| 900 | 84,910 | 399,000 | $14 |

(1) Estimated volume of PCB-contaminated sediments was calculated in Fuglevand (1996). Estimated volume of all contaminated sediments was estimated using Fuglevand (1996) and an estimate of 350,000 cy for cleanup of all contaminants other than PCBs, based on current unpublished estimates of the volume of sediment requiring cleanup to ecologically-based cleanup levels of approximately 300,000 to 400,000 cy.

(2) Estimated cost of cleanup was derived using a $35/cy estimate for nearshore fill from Hartman (1996). The estimated cost for confined aquatic disposal is approximately the same as for nearshore fill; upland

disposal would increase the cleanup cost by approximately 46%.
(3) For cleanup volumes of greater than 700,000 cubic yards, multiple disposal sites may be needed, so cleanup costs for these options may be underestimated.

Table 8 and Figure A-1 shows the volume of sediments requiring cleanup at the range of PCB cleanup levels considered. The cost of cleanup is directly related to the volume of contaminated sediments requiring cleanup, and the post-cleanup average PCB concentration gives an idea of the environmental benefit gained at each incremental increase in cleanup level. Table 9 shows the cost of cleanup as compared to the average PCB sediment concentration achieved after cleanup in Hylebos Waterway and in the CB/NT Site as a whole. Since fish and fisherpersons are likely to move throughout a waterway or throughout the CB/NT Site, the post-cleanup average gives an idea of the amount of PCB contamination these receptors would be exposed to. At PCB cleanup concentrations between 900 and 450 μg/kg, the environmental benefit in terms of reduction in the post-cleanup average PCB concentration is approximately equal to or greater than the percent increase in volume requiring remediation. Because of the large volume of sediments with PCB concentrations of 450 μg/kg or less, the volume of sediments requiring remediation becomes very high in comparison to the percent reduction in average PCB concentrations.

Table 9. Post-cleanup average PCB concentrations and cleanup costs at a range of PCB sediment cleanup levels.

| PCB Sediment Remedial Action Level (μg/kg) | Post-cleanup average concentration (Hylebos Waterway only) (μg/kg) | Post-cleanup average PCB concentration (CB/NT Site) (μg/kg) | Cleanup cost (Hylebos Waterway only) (millions) (1) |
|---|---|---|---|
| 150 | 37 | 51 | $46.5 |
| 300 | 80 | 63 | $31 |
| 450 | 124 | 75 | $18 |
| 600 | 143 | 82 | $15.5 |
| 750 | 156 | 86 | $14.5 |
| 900 | 161 | 89 | $14 |

(1) Costs presented are Hylebos Waterway cleanup costs only. Bay-wide cleanup costs can be estimated at Hylebos Waterway cost + $18 million (ROD estimated cost for cleanup of all other problem areas).

Based on this analysis, EPA has determined that a PCB SRAL of 450 μg/kg is cost-effective. A remedial alternative is considered "cost effective" if its costs are proportional to its overall effectiveness. Overall effectiveness is determined by evaluating its short-term and long-term effectiveness (and reduction in toxicity, mobility, and volume, in decisions where treatment is being considered), as discussed above. Cleanup to 450 μg/kg PCBs would significantly reduce the overall post-cleanup average PCB concentration, and subsequently, the risks to human health and the environment, in the individual waterways and in Commencement Bay as a whole.

Cleanup to the ROD SRAL of 300 $\mu$g/kg PCBs would be significantly more costly (the cost of cleanup to 300 $\mu$g/kg is about $13 million higher than the cost of cleanup to 450 $\mu$g/kg), while the difference in long-term and short-term protectiveness is not large.

Although the majority of the cost of the cleanup is associated with meeting the SRAL, there are some costs associated with assuring the SQO is met within 10 years after remedial action through natural recovery. These costs are expected to result in a very small increase to the cost of the remedy, as discussed below.

- Natural recovery predictions in the 1989 ROD will be updated with new natural recovery models using pre-design sampling data. This cost of modeling for natural recovery of PCBs will be a negligible addition to the efforts already underway at most CB/NT problem areas to predict natural recovery rates for other chemicals.

- Some additional remedial action may be required in areas where natural recovery models predict that a lower PCB SRAL is needed to achieve PCB concentrations of 300 $\mu$g/kg in 10 years after the remedial action. This may require additional remedial action at a few stations, with little impact on the overall cost of the remedy.

- Implementation of this change will require natural recovery monitoring in areas where post-cleanup PCB concentrations are between 450 $\mu$g/kg and 300 $\mu$g/kg. EPA estimates the cost of monitoring during the 10-year natural recovery period at $310,000 (Weston, 1997d).

- If models incorrectly predict natural recovery rates, additional remedial action will be needed in areas which do not naturally recover to 300 $\mu$g/kg PCBs. However, EPA believes that low cost remedial action alternatives can be used to remediate the remaining areas where PCB concentrations fall between 450 $\mu$g/kg and 300 $\mu$g/kg 10 years after remedial action. Potential remedial action alternatives include but are not limited to enhanced natural recovery, limited capping, or limited dredging, if a disposal site is readily available. EPA's best estimate is that these actions will not be needed, so contingent costs for these actions are not included in EPA's cost estimate. If additional remedial actions do prove necessary, they are expected to cost much less than the current estimated marginal cost of $13 million for full-scale cleanup of areas where sediment PCB concentrations currently fall between 450 and 300 $\mu$g/kg.

<u>State and Tribal Acceptance</u>

The State of Washington Department of Ecology concurs with the selected PCB cleanup level. Ecology's concurrence letter is included as Appendix B. The Puyallup Tribe of Indians does not concur with the selected PCB cleanup level.

Community Acceptance

Based on the public comments received during EPA's initial community relations activities associated with the PCB cleanup level and during the public comment period held from March 10 through April 9, 1997, it is clear that the community is divided on this issue. Some members of the community believe the cleanup level should be raised, while many others believe it should remain as stated in the 1989 ROD, or that the PCB standard should be even more stringent than stated in the ROD. Appendix C contains a summary of the comments received during the public comment period and EPA responses to those comments.

Summary of the Comparative Analysis of Alternatives

Based on the human health and environmental risk evaluation, and the comparative analysis of alternatives, EPA is modifying the PCB sediment SQO in the CB/NT ROD to 300 $\mu$g/kg, to replace the former SQO of 150 $\mu$g/kg. The 300 $\mu$g/kg PCB SQO must be achieved in all CB/NT problem areas within 10 years after cleanup. Because of the long-term human health risks associated with PCBs, EPA is also setting a maximum PCB SRAL of 450 $\mu$g/kg for the CB/NT Site. The SRAL must be achieved in all CB/NT problem areas during cleanup. EPA's calculations show that an average post-cleanup PCB concentration of less than 150 $\mu$g/kg will be achieved in all waterways and in Commencement Bay as a whole after cleanup to the SRAL of 450 $\mu$g/kg, and will be reduced to an average of 63 $\mu$g/kg within 10 years through natural recovery processes. EPA has selected 300 $\mu$g/kg as the appropriate PCB SQO and 450 $\mu$g/kg as the maximum PCB SRAL for the CB/NT Site for the following reasons:

- It is within the EPA's acceptable risk range for Superfund cleanups and is protective of human health cancer risks. EPA's human health risk calculations show that a PCB SQO of 300 $\mu$g/kg will result in post-cleanup residual risks for persons consuming fish from the CB/NT Site of $1 \times 10^{-4}$ for the Hylebos Waterway and the CB/NT Site as a whole, and $8 \times 10^{-5}$ for the Thea Foss Waterway. Residual risks during the 10-year natural recovery period will be only slightly higher, at $1 \times 10^{-4}$ for the CB/NT Site and Thea Foss Waterway, and $2 \times 10^{-4}$ for the Hylebos Waterway.

- It meets the NCP standard for non-cancer risks of providing post-cleanup concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Although the non-cancer HQ for the high-end tribal fishing scenario is greater than one, EPA believes that there is a sufficient margin of safety built into the estimates of toxicity and exposure to provide for protection of human health.

- The PCB SQO of 300 $\mu$g/kg and SRAL of 450 $\mu$g/kg are protective of ecological receptors. They are below the 1,000 $\mu$g/kg PCB AET calculated in the CB/NT ROD as being protective of benthic infauna. They also falls between Ecology's no adverse effects level and minor adverse effects level as promulgated under the State's SMS to protect aquatic life. The updated ecological risk analysis indicates that the SQO and SRAL are protective of juvenile salmonids, shorebirds, and piscivorous birds.

- A 450 μg/kg SRAL is the most cost-effective alternative. Remediation to a lower cleanup level requires remediation of a substantially larger volume of sediments. Cleanup to the former 300 μg/kg PCB SRAL would result in a 70% increase in the volume of sediments to be remediated in the Hylebos Waterway, and a 150 μg/kg PCB cleanup level would result in a 150% volume increase, when compared to the 450 μg/kg cleanup level. This increased volume would also result in an increase in the cost of cleanup, the area needed for a disposal site, and the area of the Waterway where aquatic organisms are disrupted during dredging.

- The 300 μg/kg PCB SQO provides for additional protection at a small additional cost. By requiring that modeling be done to confirm ROD predictions that PCB concentrations will be reduced by natural recovery processes within 10 years after cleanup, and requiring long-term monitoring and potential additional cleanup to ensure the SQO is achieved, the 300 μg/kg PCB SQO provides additional assurance of the long-term protectiveness of the remedy. Over the 10-year natural recovery period, human health cancer risks would be reduced by an additional 14% for the CB/NT Site as a whole, 34% for the Hylebos Waterway, and 31% for the Thea Foss Waterway. There will be similar reductions in non-cancer risks and ecological risks. EPA believes that establishing a maximum SRAL and a 300 μg/kg SQO is cost-effective, especially since the natural recovery component of the remedy increases the cost of the remedy by a very small amount. Even if natural recovery models have not accurately predicted the rate of natural recovery and additional cleanup is needed to achieve 300 μg/kg PCBs within 10 years after cleanup, low cost solutions such as enhanced natural recovery can be used to remediate sediments with contaminant concentrations between 450 μg/kg and 300 μg/kg PCBs.

## IV. DOCUMENTATION OF CHANGES FROM THE PROPOSED ESD

In February 1997, EPA released its draft ESD (EPA, 1997) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment SQO from 150 μg/kg to be achieved within 10 years after cleanup, to 450 μg/kg, to be achieved during cleanup. EPA received several comments on the proposed ESD, and made some modifications to the proposed remedy in response to public comments and those of the support agencies, the

Washington State Department of Ecology, and the Puyallup Tribe of Indians. The changes made in response to those comments are summarized below.

**Addition of a 300 μg/kg PCB SQO**

An SQO of 300 μg/kg PCBs has been added as an enforceable standard for the CB/NT Site, along with the 450 μg/kg PCB SRAL proposed in the draft ESD. This means that CB/NT sediments with PCB concentrations of 450 μg/kg or higher will be remediated as part of any CB/NT cleanup. In addition, natural recovery modeling will be performed to ensure that remediation of PCB-contaminated sediments to 450 μg/kg will result in PCB sediment concentrations of 300 μg/kg or below in all areas of the CB/NT Site. If natural recovery models predict that in some areas, a PCB cleanup level lower than 450 μg/kg is needed to achieve 300 μg/kg PCBs within 10 years of sediment remedial action, a lower PCB SRAL will be required in those areas.

The 450 μg/kg SRAL is being set as the maximum PCB SRAL for any problem area at the CB/NT Site. Even if natural recovery modeling shows that some areas with a higher PCB sediment concentration will naturally recover to 300 μg/kg in 10 years, areas with PCB sediment concentrations greater than 450 μg/kg PCBs must be remediated. EPA considers 450 μg/kg PCBs to be the maximum concentration of PCBs which should be allowed at the CB/NT Site after cleanup, because of the long-term health human health and ecological effects associated with PCBs.

**Addition of an Analysis of Non-cancer Risks**

In the draft ESD, EPA relied on the analysis in the 1989 ROD that a PCB cleanup level which is protective of human health cancer risks is also protective of non-cancer risks. In response to public concerns about non-cancer risks associated with PCBs, EPA performed an analysis of the residual non-cancer risks associated with cleanup of PCBs to a range of potential PCB cleanup levels (Weston, 1997b) and considered this information in its selection of the final PCB cleanup level.

**Clarification of CERCLA Requirements for Review of Protectiveness of the Remedy**

Several commentors pointed out that a considerable amount of new research is being done on the harmful effects of PCBs. In addition, NOAA continues to do research on the effects of contaminants at the CB/NT Site to wildlife. These studies may, in the future, show that the toxicity of PCBs is greater than currently believed. Section 121(c) of CERCLA states that if EPA selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, EPA shall review such remedial actions no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action. Pursuant to this statutory requirement, EPA will review the appropriateness of the remedy no less often than each 5 years after its initiation. If new studies indicate that PCBs are responsible for more toxic effects than was known at the time of this ESD, EPA will review such information to determine whether any additional remedial action is necessary to ensure the protectiveness of the remedy.

## V. AFFIRMATION OF THE STATUTORY DETERMINATION

Considering the new information that has been developed in this ESD and in the Administrative Record, EPA believes that the modified PCB SQO and SRAL values for remediation of contaminated sediments at the CB/NT Site remain protective of human health and the environment, comply with Federal, State and tribal requirements that are applicable or relevant and appropriate to this remedial action, is cost-effective, and otherwise meets the standards of Section 121 of CERCLA.

## VI. PUBLIC PARTICIPATION ACTIVITIES

EPA developed a report in October 1996 which provided human health risk calculations at a range of potential PCB cleanup levels. That report was sent to several parties for review, and EPA received 20 comment letters. EPA held a public meeting to discuss our proposed approach, which 29 people attended. As noted in Section III of this ESD, EPA made several modifications to its approach to evaluating potential cleanup levels based on these comments.

In February, EPA released its draft ESD (EPA, 1997) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment cleanup from 150 $\mu$g/kg to be achieved within 10 years after cleanup, to 450 $\mu$g/kg, to be achieved immediately after cleanup. A fact sheet was sent in March 1997 to over 2000 people announcing EPA's proposed change and inviting their comments. EPA placed a display ad in the Tacoma News Tribune on March 10, 1997 announcing the public comment period and a public meeting. A public meeting was held on March 26, 1997, to present EPA's proposal, to answer questions about the proposal, and to take public comments. This meeting was attended by approximately 50 people. The public comment period for the draft ESD and the Administrative Record (AR) of documents supporting the proposal extended from March 10, 1997 to April 9, 1997. Thirty-six verbal and written comments were received by EPA, and nine comment letters were received after the public comment period ended. All comments, including those received before and after the public comment period, were considered in EPA's decision. The AR for this decision contains all public comments EPA has received on this proposal. Appendix C contains a summary of the comments received before and during the public comment period and EPA responses to those comments.

Signed:

for Randall F. Smith, Director
Office of Environmental Cleanup

July 28, 1997
Date

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## APPENDIX A

**Table A-1—Arithmetic Mean Residual PCB Sediment Concentrations (μg/kg-DW) over a Range of PCB Cleanup Levels**

| Target PCB Cleanup Level (μg/kg-DW) | CB/NT Site-Wide | Hylebos Waterway | Thea Foss Waterway |
|---|---|---|---|
| 50 | 45 | 20 | 22 |
| 100 | 47 | 26 | 34 |
| 150 | 51 | 37 | 49 |
| 300 | 63 | 80 | 81 |
| 450 | 75 | 124 | 108 |
| 600 | 82 | 143 | 136 |
| 750 | 86 | 156 | 150 |
| 900 | 89 | 161 | 168 |

**Table A-2—Assumptions used in Human Health Residual Risk Evaluation**

| Parameter | Value[1] | Source |
|---|---|---|
| PCB oral Cancer Slope Factor ($CSF_o$) | 2.0 (mg/kg-day)$^{-1}$ | Updated toxicity value from EPA's Integrated Risk Information System (IRIS) |
| Representative PCB Residual Sediment Concentration Statistic | arithmetic mean (see values in **Table A-1**) | As recommended by EPA |
| PCB Biota Sediment Accumulation Factor (BSAF) | 1.72 | Site-specific, bay-wide value |
| Fraction Lipid in Fish Tissue ($f_{lipid}$) | 2.6% | Site-specific, bay-wide value |
| Exposure Duration (ED) | 30 yr | EPA default upper end residency value |
| Exposure Frequency (EF) | 350 days/yr | Standard default exposure factor, allows for 2 weeks away per year |
| Averaging Time (AT) | 70 yr | Standard default human lifetime, used for averaging all cancer risks |
| Body Weight ($BW_a$) | 70 kg | Average adult human body weight |

[1]Shaded values indicate those values that have been revised since the 1989 ROD.

**Table A-3—Fish Ingestion Rates used in Human Health Residual Risk Evaluation**

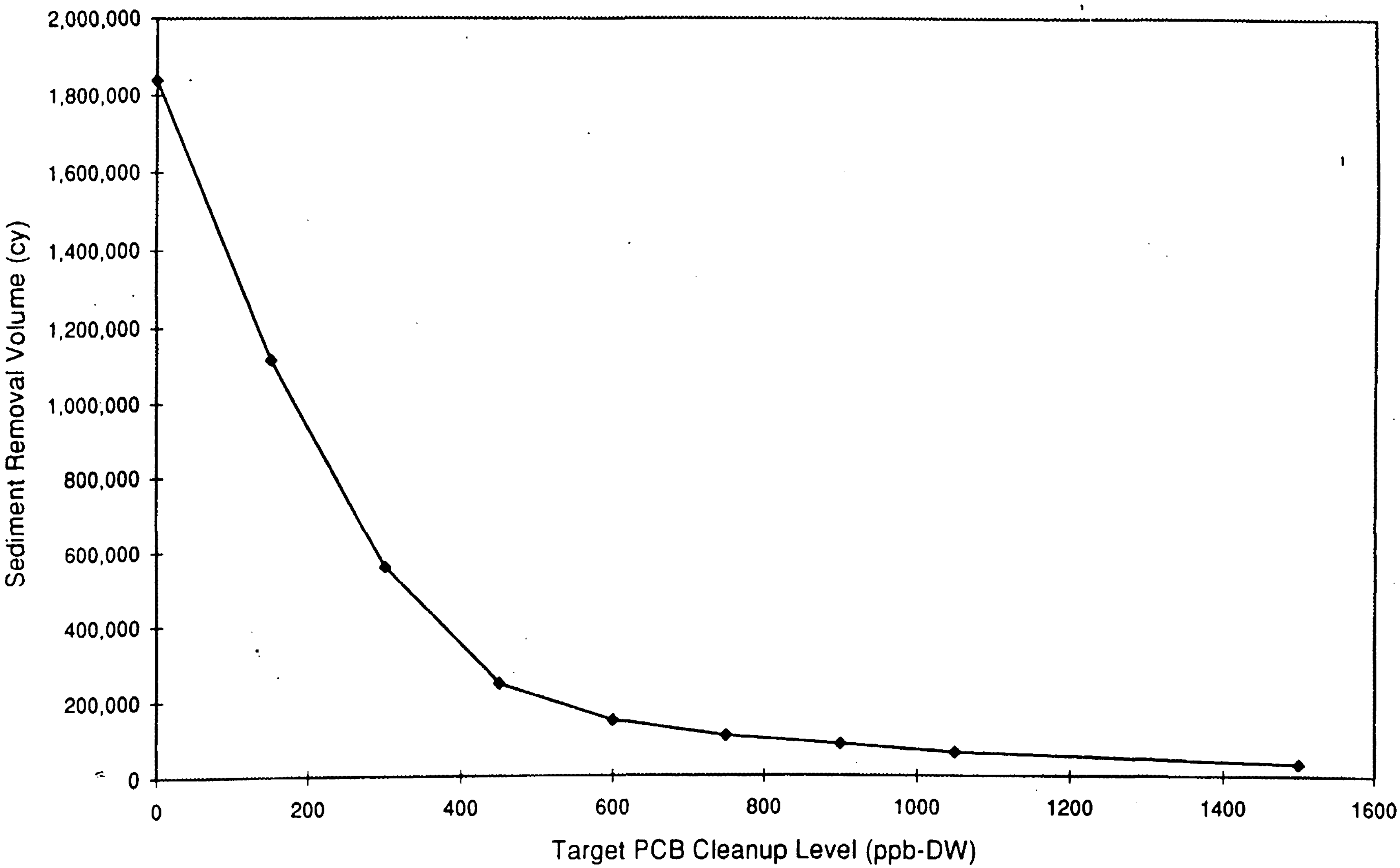
| Exposure Scenario | Ingestion Rate (g/day) | Fraction Consumed Fish from the CB/NT Site (%) |
|---|---|---|
| RME--High-end Tribal | 123[1] | 69[5] |
| Average Tribal | 41.7[2] | 69[5] |
| High-end Recreational | 95.1[3] | 100 |
| Average Recreational | 12.3[4] | 100 |

[1] Upper 90th UCL of the mean ingestion rate of all finfish from Toy et al., 1996
[2] Mean ingestion rate of all finfish from Toy et al., 1996
[3] Upper 95th UCL of the mean fish ingestion rate from Tetra Tech composite study utilized in the ROD
[4] Mean fish ingestion rate from Tetra Tech composite study used in the ROD
[5] Weighted average (based on mean consumption rates by each tribe of each type of fish) of percentages of finfish consumed from Puget Sound from Toy et al., 1996

**Table A-4–Estimated Residual Cancer Risks after cleanup to a range of PCB cleanup levels**

| Target PCB Cleanup Level (µg/kg-DW) | CB/NT Site-Wide | Hylebos Waterway | Thea Foss Waterway |
|---|---|---|---|
| 50 | 8.3E-5 | 2.7E-5 | 2.1E-5 |
| 100 | 8.7E-5 | 3.4E-5 | 3.3E-5 |
| 150 | 9.4E-5 | 4.9E-5 | 4.6E-5 |
| 300 | 1.2E-4 | 1.1E-4 | 7.6E-5 |
| 450 | 1.4E-4 | 1.6E-4 | 1.0E-4 |
| 600 | 1.5E-4 | 1.9E-4 | 1.3E-4 |
| 750 | 1.6E-4 | 2.1E-4 | 1.4E-4 |
| 900 | 1.6E-4 | 2.1E-4 | 1.6E-4 |

## Figure A-1--Hylebos Waterway Target PCB Cleanup Level vs Sediment Removal Volume




JRCE. Memorandum from Paul Fugelvand (Dalton, Olmsted Fuglevand, Inc.) to Allison Hiltner (US EPA)
jarding PCB Residual Concentration, Arithmetic Mean. December 18, 1996.

2/26/97 3:55 PM

# APPENDIX B

## WASHINGTON DEPARTMENT OF ECOLOGY LETTER SUPPORTING EPA'S EXPLANATION OF SIGNIFICANT DIFFERENCES

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

Allison

RECEIVED
JUN 1997
Environmental Cleanup Office

June 13, 1997

Mr. Randy Smith
Environmental Protection Agency
1200 6th Avenue, ECL-117
Seattle, WA 98101-3188

Dear Mr. Smith:

We appreciate having the opportunity to review and comment upon Environmental Protection Agency's Explanation of Significant Differences regarding PCBs in Commencement Bay. As you know, we've been attempting to evaluate whether your proposal will meet objectives of Washington's sediment management program after the cleanup is completed.

As the proposal currently stands, the termination of cleanup after dredging to 450 ppb will not achieve a level of protection for humans or wildlife that will meet Ecology's requirements. Ecology's goals for acceptable human health risk for carcinogens are 1 x 10-6 to 1 x 10-5 and for noncarcinogens, hazard indices for human or ecological health are not to exceed a value of one (Chapter 173-340-700 WAC).

There are, however, some very positive aspects to Environmental Protection Agency's proposal. We support the concept of removal through dredging and confined disposal and we desire to see the cleanup proceed promptly. While the proposed cleanup to 450 ppb falls short of Ecology objectives, we would endorse the implementation of a 10 year natural recovery period as an element of the cleanup to achieve further reduction of PCBs. This is consistent with the State's Sediment Management Standards where cleanup of heavier contaminated areas is undertaken initially, followed by natural recovery in areas of relatively lower concentrations.

Natural recovery would be considered appropriate by the State only if active cleanup is taken to 450 ppb at year 0 and PCBs are at or below 300 ppb at year 10 after cleanup. This ensures short term effectiveness of the remediation by limiting risk to human health and the environment over the 10 year recovery period and long term effectiveness is attributed to the final cleanup standard of 300 ppb. Also, a monitoring program to track natural recovery would have to be included. Additional active remediation would be triggered if monitoring indicates that the 10 year objective (300 ppb) would not be achieved.

Ecology's concurrence with EPA's cleanup is conditioned on the following points:

- Active Remediation to 450 ppb PCBs throughout Commencement Bay
- Recovery within ten (10) years to a maximum level of 300 ppb
- Monitoring to confirm recovery will be achieved
- Additional remedial action triggered if recovery will not meet cleanup levels
- Cleanup action to commence no later than year 2001

Ecology's has determined that this cleanup scenario ensures significant additional risk reduction with minimal additional costs expected. Over the 10 year period of natural recovery, mean concentration for PCBs would decrease from about 124 to 80 ppb for Hylebos, from 108 to 81 for Thea Foss and from 75 to 63 Bay-wide. Concurrently, human health cancer risks would be reduced by about 34% , 31%, and 14% (Hylebos, Thea Foss and Bay-wide, respectively) for the scenario that is protective of the above average Tribal subsistence fisher. Non-cancer human health hazard quotients would decrease from 9 to 6 for Hylebos, from 6 to 4 for Thea Foss and from 8 to 7 for Bay-wide and, hazard indices for 3 groups of wildlife (juvenile salmonids, shorebirds and piscivorous birds) would be reduced below one.

We believe our concepts could achieve a cleanup that makes great progress in meeting state requirements without substantial cost increases. We also recognize the difficult job the Environmental Protection Agency has in attempting to reconcile the many views presented to you and we hope that our ideas might help bring the project to a successful conclusion for all of the parties involved.

Sincerely,

Mary E. Burg

Mary Burg
Program Manager
Toxics Cleanup Program

MB:jr

cc: Dave Jansen, Ecology
Russ McMillan, Ecology

# APPENDIX C

## PUBLIC COMMENT RESPONSIVENESS SUMMARY

July 28, 1997

# TABLE OF CONTENTS

# PCB CLEANUP LEVEL REEVALUATION
# COMMENCEMENT BAY NEARSHORE/TIDEFLATS SUPERFUND SITE
# PUBLIC COMMENT RESPONSIVENESS SUMMARY

## A. OVERVIEW OF THE REEVALUATION OF THE PCB CLEANUP LEVEL AND RELATED COMMUNITY INVOLVEMENT

In 1983, the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site was placed on EPA's National Priorities List (NPL) of sites requiring investigation and cleanup. In 1989, the Record of Decision (ROD; EPA, 1989a) addressing the marine sediment problem areas within the CB/NT Site was released. The ROD addressed the seven waterways (i.e., the Hylebos, Blair, Sitcum, Milwaukee, Saint Paul, Middle, and Thea Foss/Wheeler-Osgood waterways) extending southeast from Commencement Bay, and the Nearshore area (i.e., area from the Commencement Bay shoreline to the 60-foot bathymetric contour) of the bay. (See Figure 1 in the Explanation of Significant Differences [EPA, 1997a].) It did not include the Ruston shoreline, which will be addressed in a separate ROD. The CB/NT ROD established a sediment quality objective (SQO) for polychlorinated biphenyl compounds (PCBs) of 150 micrograms per kilogram ($\mu$g/kg, dry weight) based on protection of human health from ingestion of contaminated fish. The 150 $\mu$g/kg SQO was to be met within 10 years of active sediment cleanup.

During pre-design sampling, new data were collected from the Hylebos Waterway showing that approximately twice the amount of sediment originally estimated in the ROD would require cleanup; and EPA has updated the toxicity information it used to assess human cancer risks associated with PCBs. In response to concerns about these issues, EPA decided to reevaluate the PCB sediment cleanup level for the CB/NT Site. The *Evaluation of Residual Risks Associated with a Range of Sediment PCB Cleanup Levels in the Hylebos Waterway, the Thea Foss Waterway, and the Overall Commencement Bay Nearshore/Tideflats Superfund Site* (referred to as the Evaluation of Residual Risks) was prepared in October 1996 to form a technical basis for the reevaluation of the PCB cleanup level (Weston, 1996). The report quantitatively evaluated residual risks to human health at a variety of potential PCB cleanup levels using updated sediment data, and the risk calculation and exposure assumptions in the 1989 ROD. It also contained an uncertainty analysis which qualitatively evaluated the impact of varying the assumptions used in the risk estimates. EPA distributed the Evaluation of Residual Risks report (Weston, 1996) to 31 parties and held a comment period in November 1996. EPA held an informational meeting attended by approximately 29 people on November 4, 1996, at the World Trade Center in Tacoma, Washington. EPA received approximately 20 comment letters during this informal comment period.

In response to comments on the Evaluation of Residual Risks report, EPA updated the risk equations and several of the input parameter values. This analysis was released in February 1997 as the Addendum to the Evaluation of Residual Risks (Weston, 1997a). As with the Evaluation of Residual Risks, the Addendum presents residual human cancer risks at potential target PCB sediment cleanup levels from 50 to 900 $\mu$g/kg. In addition, the Addendum includes a brief evaluation of ecological risks over a range of PCB cleanup levels. EPA considered the information presented in both the Evaluation of Residual Risks and the Addendum in its reevaluation of the PCB cleanup level.

In February, EPA released its draft Explanation of Significant Differences (ESD) (EPA, 1997a) with a proposed change to the PCB cleanup level. In the ESD, EPA proposed to modify the PCB sediment cleanup from 150 $\mu$g/kg to be achieved within 10 years after cleanup, to 450 $\mu$g/kg, to be achieved during cleanup. A fact sheet was sent in March 1997 to over 2,000 people announcing EPA's proposed change and inviting their comments. EPA placed a display ad in the *Tacoma News Tribune* on March 10, 1997, announcing the public comment period and a public meeting. A public meeting was held on March 26, 1997, to present EPA's proposal, to answer questions about the proposal, and to take public comments. This meeting was attended by approximately 50 people. The public comment period for the draft ESD and the Administrative Record of documents supporting the proposal extended from March 10, 1997, to April 9, 1997. Thirty-six verbal and written comments were received by EPA.

This Responsiveness Summary addresses comments on the October 1996 Evaluation of Residual Risks report (Weston, 1996) as well as comments shared with EPA during the public comment period following release of the draft ESD.

## B. OVERVIEW OF COMMUNITY CONCERNS AND EPA RESPONSE

Comments received by EPA on the October 1996 Evaluation of Residual Risks report (Weston, 1996) ranged from concerns that the risk calculations were overly conservative and would result in an unnecessary degree of cleanup to concerns that any increase to the existing PCB cleanup level (150 $\mu$g/kg) would not be adequately protective of people and wildlife in the vicinity of the CB/NT Site. Commentors requested the use of more up-to-date values to calculate site risks. Concerns were expressed regarding the value chosen to represent the residual PCB sediment concentrations after cleanup at the selected target cleanup levels. Commentors also requested that ecological risks associated with PCB exposure be more directly addressed.

Many of the comments requesting that EPA use updated values in its risk calculations were addressed in the February 1997 Addendum to the Evaluation of Residual Risks (Weston, 1997a). A new cancer slope factor, exposure duration, and fish consumption rate, along with updated sediment chemistry data (for PCB concentrations and total fraction of organic carbon), were used in risk calculations. A brief evaluation of risks to selected ecological receptors was performed using data provided by the natural resource agencies.

Many of the concerns expressed in November 1996 were repeated during the March 1997 public comment period, along with several additional concerns. Although some commentors agreed with EPA's proposed PCB cleanup level of 450 $\mu$g/kg, many commentors expressed concerns that the proposed cleanup level was too high or too low. Some felt that it was not adequately protective of people and ecological receptors in the vicinity of the site, while others felt that it mandates a higher cost than other potential cleanup levels (e.g., 600 μg/kg) without providing a significant increase in protectiveness. Commentors also questioned EPA's application of the nine Superfund evaluation criteria discussed in the ESD in relation to establishing the proposed new PCB cleanup level. Additionally, commentors cited a need to account for multiple chemical effects and global distributions of PCBs. Several commentors expressed concerns about non-cancer risks associated with PCBs. Some commentors were also concerned about the feasibility of cleaning up sediments to a 450 μg/kg PCB cleanup level and the potential for increased ecological risks during the remedial efforts.

In making its final decision on the PCB cleanup level for Commencement Bay sediments, EPA carefully examined data regarding cancer and non-cancer risks to both people and the environment to ensure that the proposed PCB cleanup level would be protective of both human health and the environment. In response to concerns about non-cancer human health risks, EPA evaluated potential non-cancer risks in a technical memorandum entitled "Potential for Noncancer Health Impacts from PCBs in Commencement Bay Sediments" (Weston, 1997b). This technical memorandum has been added to the Administrative Record for this ESD. EPA also added to the Administrative Record a technical memorandum on PCB concentrations in non-urban areas of Puget Sound (Weston, 1997c) to address questions about background conditions. To address concerns that EPA should provide some assurance PCB concentrations will be reduced over time, EPA added a requirement that PCB concentrations in sediments must be reduced to 300 μg/kg within 10 years after completion of the cleanup. If the 300 μg/kg standard is not achieved through natural recovery, additional cleanup work will be done to meet that standard.

Specific responses to the concerns expressed by commentors are provided in the following subsections within Section C:

Part I — Responses to Comments Received Prior to Issuance of the Draft ESD
1. Comments Regarding the Risk Evaluation Approach
2. Comments Regarding Risk Management Issues

Part II — Responses to Comments Received Subsequent to Issuance of the Draft ESD
3. Comments Related to the Proposed PCB Cleanup Level
4. Comments Related to the Risk Evaluations
5. Comments Related to Remedial Decision-Making

Part III - List of Commentors

Part I, which comprises sections 1 and 2, focuses on comments received during the 1996 comment period following release of the Evaluation of Residual Risks (Weston, 1996). Part II, which comprises sections 3 through 5, focuses on comments received during the 1997 public comment period following release of the draft ESD and supporting information, including the Addendum (Weston, 1997a). The responses to comments are followed in Part III by a list of the commentors. References are listed in Section D. Several technical terms are used in the comments and responses. To assist the non-technical reader, technical terms are defined in the glossary provided in Section E.

## C. RESPONSES TO SPECIFIC PUBLIC CONCERNS

### Part I—Responses to Comments Received Prior to Issuance of the Draft ESD

### 1 Comments Regarding the Risk Evaluation Approach

#### 1.1 Comments related to use of up-to-date values for toxicity and exposure parameters and an up-to-date equation for calculating residual risks

*1.1.1 The cancer slope factor in EPA's Integrated Risk Information System has been reduced from 7.7 (mg/kg-day)$^{-1}$ to a range of 0.04 - 2.0 (mg/kg-day)$^{-1}$. EPA's risk evaluation should use the more updated cancer slope factor to evaluate residual risk. (17, 14, 15, 6, 32)*

> **Response**: EPA agrees and has applied the updated oral cancer slope (toxicity) factor of 2.0 (mg/kg-day),$^{-1}$ as recommended for food chain exposures such as fish consumption, in the assessment of residual risks presented in the Addendum to the Evaluation of Residual Risks Report (Addendum; Weston, 1997a). The Addendum contains the residual risk calculations used by EPA in its reevaluation of the PCB cleanup level for the CB/NT Site.

*1.1.2 EPA could simply update the PCB cancer slope factor (CSF), leave all other exposure assumptions unchanged, and the PCB cleanup criterion for the Hylebos would become consistent with other RODs in the nation. Updating only the cancer slope factor in the ROD risk assessment, without changing any of the other out-dated exposure assumptions, would change the PCB cleanup criteria from 150 μg/kg to 1,500 μg/kg. If the cancer slope factor decreases from 7.7 to 2 (a decrease by a factor of 3.85) and all other parameter values remain the same (including risk), the allowable PCB concentration in fish will increase by a factor of 3.85 to 139 mg/kg. The corresponding PCB concentration in sediment will then increase to 116 mg/kg. Using the tables from Appendix B of EPA Region X's October 1996 report (Weston, 1996), a geometric mean concentration (the parameter used by EPA) of 116 mg/kg corresponds to a cleanup level of 1,500 mg/kg. By making only this one change, a roadblock to cleanup of the Hylebos would be removed without having to conduct any additional studies or risk assessments. (17, 22)*

> **Response**: As addressed in Comment 1.1.1, the updated cancer slope factor was applied to the calculation of residual risks presented in the Addendum (Weston, 1997a). However, while reducing the cancer slope factor would decrease residual risk estimates, that alone would not reflect other key changes EPA has made to exposure

values used to calculate human health risks. In the eight years since the 1989 CB/NT ROD, EPA made changes in several exposure assumptions based on new research and new EPA policies. For this reason it would have been inappropriate to update one parameter value without examining all parameter values. Furthermore, as discussed in response to Comment 1.2.2, it is more appropriate to use the arithmetic mean, not the geometric mean, to represent residual sediment concentrations of PCBs at the CB/NT Site. The Addendum includes an analysis of residual risks utilizing both updated toxicity information and updated exposure scenarios relevant to the CB/NT Site.

*1.1.3 Updated data sets should be used where practical (e.g., PCB cancer slope factors, total organic carbon in sediment, biota-sediment accumulation factors (BSAFs) for PCBs from other analyses, seafood consumption rates). (2, 33, 4, 31, 21, 8, 32, 6)*

**Response**: As noted in the responses to Comments 1.1.1 and 1.1.2, updated information concerning the cancer slope factor, as well as the exposure factors (e.g., the ingestion rate), were applied to the calculation of residual risks presented in the Addendum (Weston, 1997a). Updated parameter values were used for the cancer slope factor, the fish ingestion rate, the exposure duration, exposure frequency, and the total organic carbon fraction in the sediment. The biota-sediment accumulation factor (BSAF) value for PCBs used in the ROD was retained because it was based on site-specific data.

*1.1.4 The result of incorporating more recent values for risk parameters would undoubtedly decrease overall risk. Because EPA's report used outdated assumptions and generic values instead of current science and site-specific data, it is clear that the risk assessment should have been updated. (17)*

**Response**: As discussed in the response to Comment 1.1.3, the risk equation input parameter values were updated for all relevant parameters. However, all parameter value changes did not result in a lowering of the risk estimates. For example, while the lower toxicity factor decreased risk estimates, the higher fish ingestion rate increased the risk estimates.

*1.1.5 Some of the exposure parameter values used by EPA in their risk assessment are in excess of those appropriate for estimating a reasonable maximum exposure (RME) such as exposure duration and exposure frequency. EPA research has already established that the average exposure duration is nine years, with 30 years as the reasonable maximum. (17)*

**Response**: A 70-year exposure duration and an exposure frequency of 365 days per year were applied to risk calculations in the 1989 ROD and the October 1996 Evaluation of Residual Risks (Weston, 1996). To be consistent with updated EPA policy, a 30-year exposure duration and an exposure frequency of 350 days per year were applied to risk calculations in the Addendum (Weston, 1997a). The 350 days per year exposure frequency assumes two weeks away from home per year. EPA guidance calls for a nine-year average and a 30-year high-end exposure duration based on fixed locations for exposure such as living next to a Superfund site and assumes that people change residences every nine years (on average). This assumption does not account for the fact that many people, when they move, stay within the region and likely retain use of the same recreational areas (e.g., Commencement Bay). Since data were not available to describe residence time in larger areas, EPA's high-end default value of 30 years was used to represent exposure duration for average and high-end exposure scenarios for PCBs at the CB/NT Site.

*1.1.6 EPA justifies an exposure duration of 70 years because PCBs bioaccumulate and have an extended half-life in the body. Using bioaccumulation to justify an extended exposure duration is inconsistent with EPA Headquarters' policy, as documented in EPA's current Integrated Risk Information System (IRIS) file for the PCB cancer slope factor. (17)*

As noted in the response to Comment 1.1.5, an exposure duration of 70 years was used in the October 1996 Evaluation of Residual Risks (Weston, 1996) to be consistent with the 1989 CB/NT ROD. Exposure duration was reduced to 30 years in the Addendum (Weston, 1997a). In EPA's most recent evaluation of PCB toxicity, as documented in IRIS (EPA, 1997b), no quantitative factor was provided to account for continued exposure to PCBs from the slow release of PCBs from fatty tissue within a person's body. In neither the Evaluation of Residual Risks (Weston, 1996) nor the Addendum (Weston, 1997a), was this potential exposure factored into the risk estimates. However, in both documents, this potential impact to PCB toxicity was discussed in the uncertainty analysis so that EPA could consider this factor, at least qualitatively, in its reevaluation of the PCB cleanup level.

*1.1.7 National guidance calls for risk assessments to evaluate risk for both the average exposure and the reasonable maximum exposure (RME). Based on their choice of parameter values in the October 1996 report, EPA Region X has assessed the RME. (17)*

**Response**: The PCB cleanup level in the 1989 ROD was based on a risk analysis using fish consumption rates for an average recreational fisher. The Evaluation of Residual Risks (Weston, 1996) applied that scenario as a reasonable exposure scenario for the Site. As noted in responses to several of the previous comments, several adjustments to the risk assessment input parameters were needed to update the risk assessment to develop what would be considered a reasonable maximum exposure (RME) under current EPA guidance. The analysis of residual risks presented in the Addendum (Weston, 1997a) included evaluations of average and high-end recreational fisher scenarios, as well as average and high-end tribal fisher scenarios. EPA chose the high-end tribal fisher scenario to represent the RME for the CB/NT Site.

*1.1.8 EPA did not reduce the concentration of PCBs in fish as a result of cooking in spite of the fact that the decrease has been documented in the scientific literature. (17)*

**Response**: As discussed in the uncertainty analysis in the Evaluation of Residual Risks (Weston, 1996), reduction of PCB levels in fish following cooking was considered. It is recognized that the various methods of preparing fish for consumption may affect concentrations of PCBs in tissue consumed. Although some studies report that cooking can substantially reduce PCB concentrations in fish tissue, other studies have shown that PCB loss during cooking may be as little as two percent. Some cooking methods also activate or create other carcinogenic chemicals. Because of the uncertainties about the net effects of cooking on PCB concentrations in fish tissue, quantitative corrections for the effects of cooking in the risk assessment are not possible at this time.

Furthermore, even if the PCB content in fish tissue decreased, content of the "pan juices" may include lost PCB amounts from the fish tissue; should these "pan juices" be consumed (e.g., used to make a sauce, or directly poured over the fish), the decrease in PCB fish tissue levels will be balanced, and individuals may still be exposed to nearly one hundred percent of PCBs present in the fish tissue. Also, some cooking methods remove far less PCBs than others; therefore, EPA's assumption of 100 percent of PCBs remaining after cooking was considered appropriate to ensure that derived cleanup levels would be protective of individuals who prepare their fish any number of ways.

## 1.2 Comments related to the calculation of residual PCB sediment concentrations

*1.2.1 The statistical assumptions and methods used for the calculation of the residual sediment PCB concentrations (such as the use of half the sample's reported detection limit for a concentration value) do not appear to be completely supported by the data and could result in a bias (lowering) of the risk estimate. (8)*

**Response**: Use of half the sample detection limit as the concentration for an undetected analyte is consistent with EPA risk assessment methodology. It assumes that the actual PCB concentrations are evenly distributed between zero and the detection limit, and may either over- or underestimate the true concentration (resulting in either an elevated or lowered estimate of risk). These possibilities are acknowledged in the uncertainty analysis presented in the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) reports. EPA considered these uncertainties in its reevaluation of the PCB cleanup level.

*1.2.2 The assumption of a lognormal distribution for the data set does not appear to be completely supported by the data and could result in a bias (lowering) of the risk estimate. The uncertainty associated with use of the geometric mean should be discussed. (8, 2)*

**Response**: In preparation of the Evaluation of Residual Risks report (Weston, 1996), the distribution of the PCB concentration data was generally found to be lognormal for the individual waterways and for the overall CB/NT Site. This follows the theoretical distribution of most environmental chemical data. Based on this analysis, a decision was made to assume a lognormal distribution; therefore, a geometric mean concentration was used to represent the average residual PCB sediment concentration in the Evaluation of Residual Risks report (Weston, 1996).

However, because use of the geometric mean concentration is not consistent with current EPA risk assessment policy (EPA, 1992), the analysis presented in the Addendum (Weston, 1997a) applied the arithmetic mean residual PCB sediment concentration. Use of the arithmetic mean provided a more conservative representation of the residual PCB concentration to which fish would be exposed and, therefore, allowed for the possibility that some fish may be exposed to higher than average concentrations of PCBs in the sediments due to a limited home range or a preference for feeding in the more contaminated areas. See also EPA's response to Comment 4.1.2.

*1.2.3 The arithmetic mean is appropriate regardless of the pattern of daily exposure over time or the type of statistical distribution that might best describe the sampling data. The geometric mean of a set of sampling results, however, bears no logical connection to the cumulative intake that would result from long-term contact with site contaminants, and it may differ appreciably from - and be much lower than - the arithmetic mean...Thus, preferential feeding by smaller forage fish in the more contaminated intertidal areas, ultimately results in a greater body burden in the larger fish that feed on these fish, than would be estimated by either an arithmetic mean, or an area-weighted average. (24)*

**Response**: As discussed in the response to Comment 1.2.2, the arithmetic mean residual PCB sediment concentration was used in the risk evaluations presented in the Addendum (Weston, 1997a).

*1.2.4 The original EPA assessment considered a population that is a hybrid between the RME and the average exposure. For example, the fish consumption value is for average exposure; the concentration value is the geometric mean of PCB concentration in fish which is lower than both the arithmetic mean (which according to EPA guidance, should be used to assess average exposure) and the 95th percent confidence interval on the mean (which according to EPA guidance, should be used to assess the RME). (17)*

**Response**: As noted in previous comments, EPA agrees that the evaluation of risks in the 1989 ROD is not consistent with current EPA guidance for estimating either an average or a reasonable maximum exposure (RME). Both the fish consumption value and the residual sediment concentrations were modified in the risk evaluation presented in the Addendum (Weston, 1997a). As discussed above in response to Comment 1.1.7, four exposure scenarios were evaluated, the RME scenario being represented by an high-end tribal fisher. As discussed in response to Comment 1.2.2, the arithmetic mean was used to represent the residual PCB sediment concentration used in risk calculations in the Addendum (Weston, 1997a). See the response to Comment 4.1.2 for a discussion of use of the 95th percent upper confidence level.

*1.2.5 On the basis of demographic and fish consumption information for this region, it is unlikely that a large number of individuals would obtain a large percentage of the fish they consume from either the Hylebos or Thea Foss/Wheeler Osgood Waterways within the CB/NT site. Therefore, the range in risk represented by the entire Site should be used as the basis for decisions. (2)*

**Response**: EPA agrees.

*1.2.6 The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Information that would allow such an evaluation include: analysis of the adequacy of the available sediment samples for determining a geometric mean of sediment for the CB/NT Site. (2)*

**Response**: Analyses of sample adequacy and the uncertainty associated with using sediment samples to estimate fish tissue concentrations are qualitative analyses. However, over the past three years, more than 200 sediment samples have been collected from each of the Hylebos and the Thea Foss waterways, waterways in which PCBs were identified as a major contaminant of concern. These samples were incorporated into the residual risks estimated in both the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a). EPA considers this an adequate number of samples to characterize PCB levels. Use of the geometric mean is further discussed in responses to Comments 1.2.2 and 4.1.2.

*1.2.7 The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Information that would allow such an evaluation include presentation of the pre-cleanup geometric mean sediment level and discussion of the drop in geometric mean sediment levels under each SQO in relation to the desired drop in fish PCB levels from 330 μg/kg (i.e., ratio of pre-cleanup sediment and fish tissue level should be equivalent to ratio of post-cleanup sediment and fish tissue level). (2)*

**Response**: The information requested in this comment is presented in Tables 3-2, 3-3, and 3-4 of the Evaluation of Residual Risks (Weston, 1996). As stated in this report, it is assumed that there is a linear relationship between the residual sediment PCB concentration and the fish tissue PCB concentration.

## 1.3 Comments related to uncertainties associated with the residual risk estimates

*1.3.1 EPA claimed that uncertainty related to the several factors in the risk equation would balance out because of perceived changes in several of them, affecting the risk estimates in both directions. This rationale does not address the question of magnitude, where one or a few factors carry significant weight or value in the equation. The analysis as presented does not provide enough information to evaluate the effects on risk estimates of raising SQOs for CB/NT. Quantitative description of uncertainty and variability in the data should be incorporated into the risk estimates. (2, 33, 8)*

**Response:** Qualitative and semi-quantitative uncertainty analyses were conducted for the Evaluation of Residual Risks (Weston, 1996) and are summarized in the Addendum (Weston, 1997a). EPA did not attempt a quantitative uncertainty analysis because it would have been an extremely difficult undertaking, and would have been only marginally more useful than the qualitative uncertainty analysis for the purposes of decision-making. Uncertainty is inherent in most risk calculations due to natural variability and uncertainty in various input parameters, some of which can, and some of which cannot, be quantified. EPA considered all uncertainties linked with residual risk estimates presented in both the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) in its reevaluation of the PCB cleanup level for the CB/NT Site.

*1.3.2 This proposed SQO represents a potential concern because nonionic organics (including PCBs) require normalization to total organic carbon (TOC) to reduce a major source of variability which are attributed to the differences in the amount of carbon....given that the organic carbon data from Hylebos Waterway and Thea Foss/Wheeler-Osgood Waterway range from approximately 0.4 to 13.5 percent (Table A-1) and from 0.3 to 16 percent (Table A-7) respectively; this could result in an error between one to two orders of magnitude (ten to one hundred fold) based upon sampling alone. (12)*

**Response:** As described in the first equation in Section 2.2 of the Evaluation of Residual Risks (Weston, 1996), the fraction of total organic carbon (TOC) in sediment is accounted for in the calculation of the residual PCB fish tissue concentration from PCB sediment concentration. In the Addendum (Weston, 1997a), the TOC values were updated to reflect current sampling data. The fraction of total organic carbon was calculated for the overall CB/NT Site, for the Hylebos Waterway, and for the Thea Foss Waterway, using data collected over the past three years. EPA considers this application of average organic carbon fractions representative of the range of organic carbon fractions throughout the CB/NT Site, including its waterways, and considers this appropriate for use in the evaluation of residual risks.

*1.3.3 Fish tissue concentrations should always be expressed in terms of a lipid-normalized value when dealing with nonionic organic chemicals. This reduces the variability that lipid (fat) has on sample concentrations. (12)*

**Response:** EPA recognizes the need to account for lipid normalization when evaluating the bioaccumulation of PCBs from sediment into fish tissue. Lipid normalization is addressed via the first equation in Section 2.2 of the Evaluation of Residual Risks (Weston, 1996) and via equation 2 in the Addendum (Weston, 1997a). The fraction of fish lipid content is included in the calculation of the residual PCB fish tissue concentration. The fraction used in this calculation was a site-specific value calculated in support of the ROD (EPA, 1989a). Additionally, this same fraction of fish lipid was applied to residual risk calculations presented in the Addendum (Weston, 1997a).

*1.3.4 When PCBs are not present, it cannot be concluded that if other chemicals are cleaned up to levels which are protective of ecological endpoints, that these levels would also be considered protective of human health. All chemicals with a log $K_{ow}$ value of greater than 5 should be examined to ensure that sediment criteria that are based on human health do not suggest a lower cleanup level than ecological criteria values. (12)*

> **Response:** In developing the 1989 ROD, EPA used a human health risk assessment to determine which chemicals may cause a human health threat to consumers of fish and shellfish. It was determined that only PCBs were present in sufficiently high concentrations in fish and shellfish to pose a threat to humans. Therefore, the ecologically based cleanup criteria for all contaminants except PCBs will result in residual contaminant concentrations that are protective of human health.

## 1.4 Comments related to exposure scenarios evaluated

*1.4.1 While the 1981 Pierce survey did not address waterway by waterway use of the bay, 25 percent of respondents reported fishing or harvesting shellfish in the Commencement Bay area. This summer, a CHB volunteer pollution monitor in the Hylebos Waterway witnessed a commercial trawler harvesting fish from the waterway. CHB's survey and monitoring of the bay and its waterways clearly illustrate that people are using the area for fishing. Protection of the community's health must remain a priority when considering any change in the PCB cleanup level. (8)*

> **Response:** EPA agrees that protection of human health must be a primary consideration in its reassessment of the PCB cleanup level for the CB/NT Site. EPA's policy is to base its risk assessments on a "reasonable maximum exposure" scenario. Because the CB/NT Site is part of the usual and accustomed fishing grounds for the Puyallup Tribe, EPA modified its assumptions for fish consumption rates from those presented in the 1996 Weston report to reflect a tribal fishing scenario. The 1997 Weston Addendum evaluates risks to a tribal member who consumes a higher than average amount of fish from the CB/NT Site. By protecting tribal members, who generally consume more fish than recreational fishermen, EPA believes it is setting cleanup levels which are protective for all members of the community.

*1.4.2 Subsistence fishing is no longer done by the Tribes, not just because of contamination, but because times have changed. (21)*

> **Response:** EPA policy and regulations require that Superfund sites be cleaned up to concentrations low enough to be protective under both current and reasonably likely future uses for a site. EPA guidance requires that we evaluate risks associated with the "highest level of exposure and risk that can be reasonably expected to occur" for anticipated future uses of the site (EPA, 1991). Members of the Puyallup Tribe have treaty rights to fish in Commencement Bay. In addition, members of the Tribe have indicated to EPA that they would fish more in Commencement Bay if the contaminated

sediments were cleaned up and they were not concerned about eating contaminated fish (see Comment 1.4.3). For these reasons, EPA believes that a tribal fishing scenario is an appropriate scenario to consider in the reevaluation of PCB sediment cleanup levels.

*1.4.3 Many activities including recreation, fishing, and shellfishing, are no longer being pursued by the Tribe due to the negligence of industry in the Hylebos Waterway. (29)*

**Response:** As indicated in response to Comment 1.4.2, EPA requires that both current and reasonably likely future uses for a site be evaluated. EPA acknowledged potential use of the CB/NT waters by the Tribe and, therefore, considered risks to tribal fishers in the Addendum (Weston, 1997a).

*1.4.4 There is no documented subsistence fishing in the Hylebos Waterway. As noted by EPA, the Pierce et al. study (1981) did not document subsistence fishing activities in the Commencement Bay area. Although we do not dispute that more intensive fishing can be associated with Native American culture or subsistence factors, the cited studies are not relevant to Hylebos for the following reasons...Although Native Americans fish in Commencement Bay and in the Puyallup River, there is no evidence of Native American fishing in the Hylebos. In fact, site-specific data (Pierce et al., 1981) found only one Native American catching fish in the entire summer survey and none in the fall survey out of the about 500 total individuals surveyed for the entire area. (17)*

**Response:** See response to Comment 1.4.2. Data on current practices alone are not always sufficient to evaluate potential future exposures, such as that resulting from an increase in Native American or subsistence fishing. Additionally, it should be noted that the design of the Pierce *et al.* study may have underestimated fish catch by the subsistence fishing population. Subsistence fishers often harvest at different times than recreational fishers, so they may have not been present at times when the surveyors were observing. Also, subsistence fishers may be less likely to share information with surveyors. The RME scenario evaluated by EPA was based on a fish consumption survey for Native Americans in the Puget Sound area. This scenario, with its relatively high consumption rate, is expected to be protective of non-tribal subsistence fishers as well.

*1.4.5 Prior to changing the existing cleanup level for PCBs, it would be beneficial to assess current fish consumption rates (the old data were collected prior to the installation of the Les Davis Pier and the posting of the waterways with fish consumption warning signs). (34)*

**Response:** As noted in responses to Comments 1.4.1 and 1.4.2, EPA requires that both current and reasonably likely future use of a site be evaluated. Fish consumption rates used in the ROD for the recreational fisher were determined by examination of four different consumption studies, including the Pierce *et al.* study (1981). To calculate risks to the reasonably maximally exposed individual, EPA used high-end tribal fish ingestion rates as reported in a 1996 study representing two tribes from the

Puget Sound area (Toy *et al.*, 1996). EPA considered these fish ingestion data as the most representative data to account for current and potential future human exposures. A study conducted to assess current use of the CB/NT waters would be confounded by the fact that several measures, including the posting of warning signs by the Tacoma-Pierce County Health Department (TPCHD), have been taken to discourage fishing in CB/NT waters. Therefore, a study of current conditions would not necessarily address potential future uses. Furthermore, fish consumption studies require a considerable amount of time. Conducting additional consumption studies at this time would involve a large time delay in cleanup. Because available data are considered of adequate quality, EPA does not believe that additional studies are warranted at this time.

*1.4.6 Documentation should be provided to substantiate EPA's assumption that although the number of people may be small, some individuals gather 100 percent of their fish from the Hylebos Waterway. (17)*

**Response**: EPA is unaware of any documentation on whether or not some individuals currently collect fish exclusively from the Hylebos Waterway. However, EPA must make cleanup decisions based on current and potential future exposure scenarios. For the CB/NT Site, EPA is basing its PCB cleanup decision primarily on overall CB/NT Site-wide risks. Waterway-specific risk estimates are presented to provide information on the possible extreme exposures and to help EPA put CB/NT Site-wide risks into perspective.

*1.4.7 Although we do not dispute that more intensive fishing can be associated with Native American culture or subsistence factors, the cited studies are not relevant to Hylebos for the following reasons. Toy et al. (1994) is not site-specific. Site-specific data indicate that Native American fishing in the area is primarily focused on salmon, which are not caught productively in the Hylebos. Furthermore, since salmon spend little of their life in the waterways, the PCB concentrations in salmon would have little, if any, relationship to the PCB concentrations in the Hylebos. (17)*

**Response**: First, whether or not subsistence fishing currently occurs at the CB/NT Site, it is a reasonable future use scenario and must be considered when evaluating residual risks present at the Site (see responses to Comments 1.4.1 and 1.4.2). While the Toy *et al.* (1996) study was not conducted for the tribes in the immediate area of the CB/NT Site, it was conducted for two tribes that each gather fish from the Puget Sound area. In this case, the collection of current site-specific data on fish consumption would reveal only current fish consumption rates and an approximation would still have to be used for the case of future exposure scenarios.

Additionally, while salmon may be the favored species, it is not the only species of fish caught from the CB/NT Site. English sole were evaluated in the risk assessment as a surrogate species to represent fish consumed from the CB/NT Site. Although salmon spend less time in the CB/NT area, they have a higher lipid content than English sole, and they tend to bioaccumulate PCBs at a higher rate. Therefore, despite the salmon's more transient residence in the CB/NT area, it is not certain that it will have accumulated significantly lower levels of PCBs from the CB/NT sediment than the English sole (see response to Comment 1.4.13).

Finally, although EPA used a reasonable maximum exposure scenario based on potential exposures to Native Americans, this scenario is also meant to be protective of subsistence fishers who are not Native American and who may be consuming fish other than salmon.

*1.4.8 The report fails to address subsistence consumption. Much of EPA Region X's position to retain the previous risk assessment centered on protecting subsistence fishermen and their families. However, EPA did not use an ingestion rate representative of subsistence fishing in the ROD. (17, 29)*

**Response**: The commentors are correct that the 1996 Weston report did not address subsistence fishing. The report has been revised to include residual risk estimates for Tribal fishers (one example of a population of subsistence fishers in the Commencement Bay area) (Weston, 1997a). See also the response to Comment 1.4.4.

*1.4.9 Use of an industrial future use scenario for the Hylebos Waterway is consistent in spirit with the USEPA Memorandum entitled "Land Use in the CERCLA Remedy Selection Process," by Elliott Laws (1995) which calls for realistic future land use assumptions and recognizes industrial land use as a "reasonable assumption where a site is currently used for industrial purposes." (17)*

**Response**: Elliott Laws' May 25, 1995, memorandum entitled "Land Use in the CERCLA Remedy Selection Process" states that EPA will use reasonably anticipated future use scenarios in developing remedial action objectives for Superfund cleanups. Seeking a way to apply this memorandum to the CB/NT Site, the commentor proposes that the Hylebos Waterway should be viewed like an industrial upland site. Comparing an upland to an aquatic site is inappropriate for several reasons, as discussed below.

First, EPA's mandate for protection of aquatic resources is entirely different than for protection of upland properties. The Clean Water Act sets forth a national goal for water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water (CWA §101[a]). The Clean Water Act, under Sections 302 and 303, also charges the States with responsibility for establishing water quality standards for all waters of the state, including designation of the uses for which a water body is to be protected. The Hylebos Waterway has been designated in Washington's Water Quality Standards (Chapter 173-201A WAC) as a Class B water body. Class B water bodies shall be protected for the following uses:

water supply (industrial and agricultural),

- stock watering,
- fish and shellfish (salmonid migration, rearing and harvesting; other fish migration, rearing, spawning, and harvesting; clam, oyster, and mussel rearing and spawning),
- wildlife habitat,
- recreation (secondary contact recreation, sport fishing, boating, and aesthetic enjoyment), and
- commerce and navigation.

The State of Washington has also identified goals for marine sediments in the 1989 Puget Sound Water Quality Management Plan. This plan sets forth a conceptual sediment quality goal of the absence of acute or chronic adverse effects on biological resources or significant human health risk. This goal was incorporated into the Sediment Quality Objectives in the CB/NT ROD and subsequently led to the development of the State Sediment Management Standards.

The Hylebos Waterway serves several functions other than industrial use. Most importantly, it serves as habitat for a variety of marine organisms. The habitat functions of the CB/NT Site are a critical component of the CB/NT ROD and habitat considerations must be incorporated into CB/NT cleanup plans.

Second, EPA can take measures to restrict access and exposure to contaminants at an upland site, and can work with local zoning authorities to ensure that future land use will remain industrial. EPA cannot restrict access or exposure to contaminants at the Hylebos Waterway by marine organisms or humans. Recent development trends in the Hylebos Waterway, including construction of the Chinook Marina by the Puyallup Tribe (which is close to an area with high levels of PCBs), indicate that the public may have increased access to the Hylebos Waterway in the future.

*1.4.10 The analysis of human health impacts from PCBs is inadequate to protect tribe members who consume large quantities of fish, crab, and shellfish. Consumption rates of shellfish should also be included with consumption rates of finfish species to reflect the total consumption rate of seafood from the study area. (29, 12)*

**Response**: As indicated above, risks for tribal fishers (one example of a population of subsistence fishers in the Commencement Bay area) are presented in the Addendum (Weston, 1997a).

Consumption of crab and shellfish, grouped into the shellfish category, was considered in a previous risk assessment (Versar, 1985) conducted as part of the remedial investigation for the CB/NT Site. This risk assessment estimated the risks associated with contaminated shellfish to be approximately the same as the risks associated with eating contaminated finfish. In the risk assessment presented in the CB/NT ROD, consumption of English sole was used as a surrogate for consumption of other finfish and shellfish at the CB/NT site. It was determined in the ROD that an evaluation based on finfish consumption would be adequately protective of human health concerns related to seafood consumption from the CB/NT site. This assumption was also used in the reevaluation of residual risks associated with PCBs in the Addendum (Weston, 1997a).

*1.4.11 Consumption rates need to address exposure rates of sensitive populations which may be consuming seafood from the Commencement Bay area. These populations are not well served by the moderate recreational seafood consumption rate of 12.3 grams per day. (12)*

**Response**: EPA agrees. As discussed in responses to Comments 1.1.6 and 1.4.1, the risk evaluation presented in the Addendum (Weston, 1997a) was based on a revised set of exposure scenarios, including an upper-end tribal fishing scenario that was selected to better represent a reasonable maximum exposure to PCBs at the CB/NT Site. A consumption rate of 123 g/day, 69 percent of which was expected to come from the CB/NT Site, was used to represent a high-end tribal fisher.

*1.4.12 There are no data to indicate whether shellfish bioaccumulate more PCBs than finfish and EPA's own risk assessments assumed the same level between the two. Thus, there will be no impact on the risk assessment results from considering shellfish. (17)*

**Response**: As indicated in the response to Comment 1.4.10, shellfish consumption was not included in the risk assessment used to support the PCB SQO in the CB/NT ROD (EPA, 1989a), nor in the subsequent evaluations conducted for the reevaluation of the PCB cleanup level.

*1.4.13 In using PCB concentrations in English sole to represent PCB concentrations in all fish, EPA assumes that the ingestion of fish is 100 percent English sole. Using PCB concentrations in English sole to evaluate PCB concentrations in salmon and other fishes is inappropriate. The Washington State Department of Health determined that English sole is not an accurate indicator of human health risks. English sole account for less than one percent of the fish consumed. Furthermore, EPA notes that using the predicted concentration of PCBs in English sole to represent the concentration of PCBs in all fish is conservative because: 1) English sole may not be representative of the majority of fish caught and eaten; and 2) English sole may bioaccumulate PCBs to a greater degree (a factor of 3 by EPA's own estimate) than the more typically eaten fish. EPA's report did not consider the site-specific data available that would portray a more realistic cross section of fish species consumed. (17)*

**Response**: Each individual who consumes seafood from the CB/NT Site likely eats a slightly different type and number of the various types of seafood found in the area. To estimate the contaminant concentrations in seafood, EPA sampled and analyzed English sole, which occur in relatively large numbers in Commencement Bay. The use of surrogate or representative species, such as English sole, to represent the various types of seafood that might be eaten is a common practice in estimating risk from fish consumption at Superfund sites and other potentially contaminated areas.

English sole were chosen because they were cited in the remedial investigation report (Tetra Tech, 1985) as a conservative indicator of the contaminant levels that would be expected to occur in edible tissue of harvested fish species. This is in large part because they live in close association with the sediments and would be expected to accumulate contaminants from sediments. Recent reports by the Puget Sound Ambient Monitoring Program (PSAMP) on PCB concentrations in fish caught throughout Puget Sound also show that the average PCB concentrations found in English sole fillets are at the high end of the PCB concentrations found in most fish species in the Sound (O'Neill *et al.*, 1995). The PSAMP data also show that contaminant concentrations in English sole muscle tissue also correlate well with contaminant concentrations in nearby sediment samples.

Chinook and coho salmon had higher Puget Sound-wide average PCB concentrations than English sole, most likely due to their higher lipid content. Although salmon is an important food item for people in the Commencement Bay area, it was not considered to be a good species to use for the Superfund risk assessment because PCB concentrations in salmon tissue in general do not correlate well with site location, and salmon have a relatively short residence time at the CB/NT site. Therefore, EPA considers use of English sole as a surrogate species an appropriate approach for its reassessment of residual risks associated with PCBs in sediments.

*1.4.14 The most important fish species consumed in the area (by weight) are salmon and squid - both of which do not spend considerable time in the Hylebos. (2)*

**Response**: While these fish do not spend all of their time at the CB/NT Site, they do spend some of their time there. In that time, these fish are exposed to CB/NT contaminants, including PCBs. The risk estimates presented in the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) accounted for consumption of all finfish, including salmon. Salmon, with their higher lipid content, (see response to Comment 1.4.13) likely accumulate some PCBs from the CB/NT Site even with a low residence time. Therefore, it is reasonable to consider consumption of these fish from the CB/NT vicinity as contributing to human health risks attributable to CB/NT contaminants.

*1.4.15 It is not reasonable to assume that people consume fish livers from CB/NT fish on a regular basis. (22, 17)*

**Response**: Although ingestion of fish livers was considered in the original CB/NT risk assessment, it was not a scenario retained in the risk evaluation supporting the PCB SQO presented in the 1989 ROD, nor was it considered in the Evaluation of Residual Risks (Weston, 1996) or the Addendum (Weston, 1997a).

*1.4.16 EPA's PCB Report (Weston, 1996) does not clearly identify the population being assessed. As a result, a hybrid of assumptions are used that apply to no particular population. If cleanup decisions are to be based on risk assessment, site-specific exposure assumptions need to be used that account for the type and amount of fish actually consumed by the real population for a reasonable duration. While subsistence anglers might indeed consume more than the amounts listed in the EPA report, the anglers are not fishing in the Hylebos, they are not consuming English sole, and they are not consuming them for more than 30 years. By calculating one risk number for a "hybrid" exposure scenario, it is impossible to know who is being assessed in EPA's assessments. (17)*

> **Response**: The risk scenario that was established in the ROD (EPA, 1989a) and applied in the Evaluation of Residual Risks (Weston, 1996) was not a hybrid scenario; it comprised a recreational fisher who consumed average amounts of fish. The exposure assumptions used were consistent with site-specific information and risk assessment guidelines and policies available at the time. Residual risks presented in the Addendum (Weston, 1997a) were updated to reflect current EPA risk assessment guidelines (including the values applied to exposure duration), and were calculated for four different exposure scenarios (i.e., both average and high-end recreational and tribal fishers).

*1.4.17 Current EPA policy, as articulated by EPA Administrator Carol Browner and others calls for risk assessments to present and discuss a range of values, to discuss the impact of parameter choices on the risk numbers, to discuss the populations being assessed, and to the extent possible, make reasonable assumptions for each population being assessed. (17)*

> **Response**: A range of parameter values and exposure scenarios was considered in the risk assessment presented in the ROD (EPA, 1989a). The Evaluation of Residual Risks (Weston, 1996) presented only one of the scenarios from the ROD (EPA, 1989a) because that scenario was used to calculate residual risks associated with the PCB cleanup level developed in the ROD. The uncertainty analysis presented in the Evaluation of Residual Risks (Weston, 1996) explored the impacts of different parameter choices on the residual risk estimates. Additionally, the Addendum (Weston, 1997a) presents residual risk estimates for four different exposure scenarios: average and high-end recreational fishers, and average and high-end tribal fishers. The high-end tribal fisher was chosen to represent the reasonable maximum exposure scenario; other risk estimates were provided to show the range of risks at the Site. As discussed in response to comments in Section 1.1, up-to-date parameters were applied to risk calculations for the Addendum (Weston, 1997a). Responses to previous comments in Section 1.4 discuss the reasonableness of parameter values and exposure scenarios evaluated in the risk evaluations (Weston, 1996, 1997a) conducted in support of the reevaluation of the PCB cleanup level.

*1.4.18 The report fails to identify cumulative health impacts from a variety of chemicals, and fails to address impacts via a number of pathways. (29)*

**Response**: See response to Comment 4.6.1.

## 1.5 Comments related to fish/sediment bioaccumulation data

*1.5.1 Use of an empirical Biota-Sediment Accumulation Factor (BSAF) of 4.0 for English sole is inconsistent both with the site-specific results of 1.4 and with EPA risk assessment guidance. (17)*

**Response**: EPA did not use a BSAF of 4.0 in any of the risk calculations for the CB/NT Site. The BSAF applied to risk calculations in the ROD, the Evaluation of Residual Risks (Weston, 1996) and the Addendum (Weston, 1997a) was 1.72, which is a site-specific value based on empirical data gathered from Commencement Bay. EPA believes that it is more appropriate to use this site-specific value rather than a literature-based value of 4.0 or the value of 1.4 calculated by Gradient Corporation (Gradient, 1995).

In 1995, Gradient Corporation calculated a site-specific BSAF of 1.4 based only on data from the Hylebos Waterway. The value of 1.4 was based on 1984 fish tissue data and 1994 sediment data. Gradient back-calculated PCB sediment concentrations using the BSAF of 1.72 and the calculated fish value. EPA does not believe Gradient's value of 1.4 is appropriate because: (1) it was calculated specifically for the Hylebos Waterway, while EPA believes it is more appropriate to assess risks to people fishing over the entire CB/NT Site, and (2) it is not appropriate to compare two data sets collected 10 years apart to calculate a BSAF. Also, as shown by Gradient's own calculations, the use of their BSAF would have very little impact on estimated PCB concentrations in fish and estimated residual risks after cleanup.

*1.5.2 Prior to changing the existing cleanup level for PCBs, it would be beneficial to collect current fish tissue data and develop a more accurate sediment concentration-fish tissue concentration model. (34, 2)*

**Response**: EPA agrees that it would be beneficial to collect current fish tissue data, but we believe that the environmental and economic costs of a six-month to one-year delay in the sediment cleanup process that would be associated with implementing such a program outweigh the benefits. EPA believes that the site-specific BSAF of 1.72 calculated for the CB/NT ROD (EPA, 1989a) provides adequate information about fish accumulation of PCBs from sediment and that application of this value to residual risk calculations provides adequate information for reevaluation of the PCB cleanup level for the CB/NT Site.

*1.5.3 The Biota-Sediment Accumulation Factor (BASF) value of 1.72 should be rounded to 1.7. (12)*

**Response:** The BSAF of 1.72 is the actual value used in the ROD (EPA, 1989a) as reported from site-specific studies. Rounding of this value to 1.7 would have minimal, if any, impact on calculated fish tissue concentrations and resulting residual risk estimates.

*1.5.4 Identify what current science predicts to be the trigger level for bioaccumulation of PCBs. (8)*

**Response:** There is no federal or state standard that sets a "trigger level" for bioaccumulation of PCBs, nor is there one PCB concentration that is commonly accepted in the scientific community as a threshold for bioaccumulative effects. The only PCB trigger level used in the Puget Sound area is the Puget Sound Dredged Disposal Analysis (PSDDA) program's PCB bioaccumulation trigger level of 38 mg/kg organic carbon (OC) (equivalent to approximately 900 μg/kg dry weight at the CB/NT Site). Dredgers with sediments containing 38 mg/kg OC must perform and pass bioaccumulation tests if they wish to dispose of their dredged sediments a the PSDDA open-water disposal site. Because there is no "trigger level" promulgated in federal or state laws for use in sediment cleanups, EPA must use site-specific evaluations such as the one contained in this Explanation of Significant Differences to determine an appropriate site-specific standard for PCBs that is protective of human health.

## 1.6 Comments related to ecological risks

*1.6.1 The SQO should remain at 150 μg/kg total PCBs, based on the following natural resource information for sediment dwelling invertebrates and fishes. A Sediment Effects Concentration (SEC) of 303.8 μg/kg (dry weight at 1 percent organic carbon) identified by MacDonald (1994) represents concentrations of PCBs at which, more often than not, adverse biological effects were demonstrate in field studies. In a similar evaluation of a variety of data sets from marine and estuarine areas of North America, Long et al. (1995) calculated an Effects Range—Median (ER—M) of 180 μg/kg (dry weight at 1 percent organic carbon). This ER-M represented concentrations above which more than half of the reviewed studies indicated adverse biological effects. (24)*

**Response:** EPA believes that it is more appropriate to set a PCB cleanup level based on a site-specific risk assessment, rather than relying on a database of studies which may or may not have relevance to the conditions at the CB/NT site. As noted in the January 1996 Eco Update (EPA, 1996b), PCBs are one of four chemicals or chemical groups that have a relatively low correlation between chemical concentration and effects level and thus have low accuracy with respect to predicting effects. Moreover, the PCB SQO of 300 μg/kg is equivalent to the sediment effects concentration of 303 μg/kg calculated by MacDonald (1994) and is actually fairly close to the revised ER-M (i.e., there are few points in the effects database separating the values of 180 and 300 μg/kg). The 300 μg/kg PCB SQO value falls within a range identified by Long *et al.* (1995) as a probable effects range.

*1.6.2 U.S. Fish and Wildlife (FWS) has assembled a series of predictive models to illustrate the relationship between the PCB concentration in sediment and the PCB concentration that would result in the eggs of fish-eating birds (FWS, 1996a,b). These models are based on biota-sediment accumulation factors to determine the concentration in fish that would result from a given sediment concentration, and on biomagnification factors to translate this into an egg concentration. These models predict that a cleanup level of 30 μg/kg would be protective of a piscivorous bird since the predictive level of PCBs in the egg is generally below the lowest observable adverse effect level (LOAEL) for injury as determined by the Great Lakes data. However, at 150 μg/kg (the current SQO level for PCBs in the ROD), the predictive levels of PCBs in the bird egg increases and exceeds the injury threshold for the LOAEL. At 450 μg/kg the predicted concentration level of PCBs in the egg increases anywhere from 2 to 7 times higher than the threshold level. In addition, the model also illustrates the potential for greater impact to trophic levels higher in the food web, such as the federally listed peregrine falcon and bald eagle. (35)*

**Response**: EPA appreciates the information provided in the U.S. Fish & Wildlife Service's (FWS's) letter regarding impacts of PCBs to birds, and has used it to the extent possible in its revised evaluation of residual risks (see Appendix A to the Weston Addendum [Weston, 1997a]). However, EPA modified the approach proposed by FWS, to make it consistent with EPA risk assessment policies and guidelines.

For example, FWS assumed in their analysis that fish and birds would be exposed only to the highest PCB concentration present in sediments after cleanup (450 μg/kg). EPA's view is that this approach tends to overestimate risks and believes it is more appropriate to evaluate risks to wildlife by using the average post-cleanup sediment PCB concentration (75 μg/kg Site-wide or 124 μg/kg in Hylebos Waterway). This assumes that the fish and birds feed in more than one location at the site or a waterway and are exposed to a range of PCB concentrations. Even in the case where piscivorous birds may exhibit a high degree of site fidelity, their prey are potentially exposed to contaminants over a broader area. Thus, average concentrations in sediment are an appropriate estimate for fish and bird exposure. In addition, use of an arithmetic average is protective because contaminants in sediment have a statistical distribution such that an average value tends to overestimate the true midpoint of the concentrations. EPA also believes that it is important to consider that PCB concentrations will be reduced over time through natural recovery.

In addition, the assumptions used to develop the biomagnification factors (BMFs) for eagles and peregrine falcons are highly conservative and assume that biomagnification is multiplicative between trophic levels. While the BMF for fish-eating birds was derived from empirical studies of herring gulls, the raptor BMF was extrapolated from other species. Currently, the FWS is conducting studies in the Columbia River to evaluate the health of bald eagle populations in this watershed. As part of this study, selected PCB congeners were measured in eagle eggs and several species. Data presented in an interim report (FWS, 1996c) suggest that the BMF may be within the same order of magnitude as calculated for the herring gull. (BMFs for selected congeners ranged from about 10 to 90. When weighted based on the fraction represented by the individual congener, the average BMF for both prey species combined was about 40, as opposed to 265 to 845 used in FWS's model. [This also assumes that 100 percent of their diet was derived from fish]).

In summary, EPA's analysis shows that cleanup to 450 μg/kg PCBs and subsequent natural recovery to at least 300 μg/kg PCBs is protective of fish-eating birds. EPA does not believe there is sufficient information at this time to assess risks to eagles and peregrine falcons.

*1.6.3 It appears as though the proposed SQO value for PCBs is based on ecological endpoints rather than human health endpoints. (12)*

**Response**: The PCB sediment cleanup level is based on protection of human health from ingestion of fish. Ecological endpoints were presented and discussed for comparative purposes because of the concern raised by reviewers that wildlife may be more sensitive to PCB sediment contamination than people.

*1.6.4 The SQO should remain at 150 μg/kg total PCBs, based on the following natural resource information for sediment dwelling invertebrates and fishes. Further information that suggests concern over raising the SQO comes from the Hylebos Waterway fish injury studies currently being conducted by the National Marine Fisheries Service's Northwest Fisheries Science Center for the Natural Resource Trustees. This study shows that under current conditions concentrations of contaminants in juvenile chinook and chum salmon are comparable to levels previously shown to be associated with biological injury and nearly one third of adult English sole showed inhibited gonadal reproductive impairment, and up to half of juveniles displayed precocious sexual maturation. (24)*

**Response**: The recent work by the National Marine Fisheries Service (NMFS) demonstrates that deleterious impacts to sediment-dwelling invertebrates and fishes are occurring under current conditions (i.e., pre-cleanup) and further emphasizes the need for cleanup to occur as quickly as possible. The NMFS report does not identify a protective PCB sediment cleanup level. Therefore, EPA relied on risk assessment methods to evaluate potential PCB cleanup levels for the CB/NT site.

## 2 Comments Regarding Risk Management Issues

### 2.1 Comments related to consideration of additional criteria to develop a PCB cleanup level

*2.1.1 Explain why, if current Washington State Sediment Management Standards have already been used as a basis for cleanups at Eagle Harbor, Harbor Island and Ruston Way,* *those same standards are not being applied to the Hylebos Waterway cleanup. We request that the EPA alter its course and accept the current Sediment Management Standards using reasonable assumptions and up-to-date science in setting cleanup criteria for Commencement Bay and the Hylebos Waterway. (15, 7)*

**Response**: The Washington State Sediment Management Standards (SMS) are not being used as an applicable, or relevant and appropriate requirement (ARAR) for the CB/NT Site because the SMS standards were promulgated after the CB/NT ROD was signed in 1989. After a ROD has been signed by EPA, the federal National Contingency Plan (NCP) (40 CFR Part 300) provides that a State or Federal environmental regulation is an ARAR only if it is necessary to ensure that the remedy is protective of human health and the environment.

EPA evaluated the Washington State SMS requirements and determined that application of the State SMS requirements was not necessary to ensure protectiveness. In addition, it was not more stringent than the evaluation process EPA used to select a PCB cleanup level. EPA's CB/NT PCB SQO of 300 μg/kg and sediment remedial action level (SRAL) of 450 μg/kg fall within the range of numeric PCB standards which have been set under the SMS to protect aquatic life (equivalent to 130 μg/kg dry weight to 1,000 μg/kg dry weight). Although the State SMS contains a narrative human health standard, the State has not yet set a numeric standard for PCB concentrations in sediments for protection of human health. Therefore, EPA has determined that it is not necessary to consider the State SMS an ARAR to ensure the protectiveness of the remedy.

*2.1.2 Review of all EPA RODs nationwide involving PCBs reveals that the Commencement Bay ROD PCB criterion of 150 μg/kg is among the lowest in the nation. Out of 53 sites nationwide, the Hylebos is held to the lowest range of PCB criteria; for similar Superfund sites, Commencement Bay ROD PCB criteria of 150 μg/kg are also the lowest. RODs for comparable sites provide for a more realistic PCB cleanup criterion of 1,000 μg/kg, even without consideration of the 1996 update of the PCB cancer slope factor. (17)*

**Response**: Cleanup levels presented in Superfund RODs are site-specific and should not be taken out of context from the other information presented in the ROD. Although EPA strives for national consistency on the process used for determining cleanup levels for Superfund sites, site-specific circumstances often lead to selection of different cleanup standards. Some of the PCB cleanup levels at other Superfund sites may be higher than at the CB/NT Site for several reasons: (1) different exposure scenarios may be of concern at those sites, or (2) technological or feasibility issues may limit the possible extent of cleanup.

One of the things that makes the CB/NT Site different than many other Superfund sites is the relatively high potential for exposure to site contaminants by humans and wildlife. The CB/NT Site is part of the usual and accustomed fishing grounds of the

Puyallup Tribe. It is therefore important that the cleanup level take into account protection of Tribal consumers of fish, who generally consume more fish than recreational fishermen. Protection of wildlife must also be considered. The CB/NT area is used for foraging by shorebirds and other wildlife. Consideration of these factors may lead to selection of a lower sediment PCB cleanup level at the CB/NT Site than at other Superfund sites.

In addition, cleanup at several Superfund sites with PCB contamination in sediments is limited by practical constraints that are not present at the CB/NT Site. For example, at many areas in the East Coast and Great Lakes, PCB contamination is so widespread that 1,000 μg/kg is the lowest practical PCB cleanup level that can be achieved. At some sites, PCB concentrations are so high (thousands of parts per million [ppm]) that extensive engineering controls are necessary to control migration of PCBs into the water and air during dredging. Because the highest PCB concentrations at the CB/NT Site are on the order of 25 mg/kg, potential releases of PCBs during dredging can be controlled much more easily.

*2.1.3 EPA should draw on other information such as cost-benefit evaluations to support the selection of a realistic cleanup level for PCBs that will allow for the cleanup to get started. (17)*

**Response**: EPA considers cost-effectiveness as one of the nine evaluation criteria used to make Superfund cleanup decisions.

*2.1.4 EPA Region X should increase the cleanup goal for PCBs in sediments on the Hylebos Waterway from the current SQO to 150 μg/kg, dry weight to at least 600 μg/kg, dry weight. This change will decrease the cost of cleanup by approximately 35 million dollars based on volumes and cost presented in Tables ES-1 of the Evaluation of Residual Risks (Weston, 1996), while causing an insignificant increase in the potential risk to a very limited, hypothetical population. Using the numbers from your own report, the risk to a potential fisherman who spends his whole lifetime eating bottom fish daily from Commencement Bay would increase from a 5.3 chance in 100,000 to a 7.3 chance in 100,000 of contracting cancer (Table 3.4 of the Evaluation of Residual Risks.) (14)*

**Response**: EPA considered each of the nine evaluation criteria, including cost, in its reevaluation of the PCB cleanup level for the CB/NT Site. See responses to comments in Section 3.2 for discussion of particular cleanup levels.

## 2.2 Other Comments

*2.2.1 Have the sources of PCB contamination been eliminated? (8)*

**Response**: PCBs have not been manufactured since 1977. Although surplus stocks of PCBs were allowed to be used in the short-term, PCBs have been replaced in all their applications over the last 20 years. Even so, PCBs may be present at facilities in the CB/NT area if, for example, PCB-containing materials were spilled or buried in the ground.

In order to control ongoing sources of contamination to the CB/NT Site, the Washington State Department of Ecology (Ecology) has inspected or investigated virtually every industry in the Commencement Bay tideflats area. They have identified facilities they believe to be ongoing sources of contamination to the CB/NT Superfund Site, and have initiated cleanups, required permits or required implementation of best management practices to control pollution at most of them. PCBs have been found in upland soils at a few facilities, primarily along the Hylebos Waterway. Ecology has required cleanups at these facilities. Ecology hopes to complete all necessary source control activities by 1998. See response to Comment 5.4.1 for further discussion of source control activities at the CB/NT Site.

*2.2.2 To address questions regarding the risk evaluation and reevaluation of the SQO for PCBs, CHB recommends putting together a discussion forum....A neutral facilitator should moderate the discussion. (8)*

**Response**: Subsequent to receipt of this letter, EPA and Citizens for a Healthy Bay (CHB) discussed the possibility of a discussion forum with several potential participants. EPA and CHB decided that there was not sufficient interest among potential participants to hold a discussion forum. Instead, EPA initiated several activities to solicit public input and to keep the public informed about the PCB reevaluation. These efforts are described in the introduction to this responsiveness summary.

*2.2.3 This evaluation is incomplete because it analyzes potential recommendation scenarios as if PCBs were the only contaminant of concern in Commencement Bay. (24)*

**Response**: As stated in the CB/NT ROD, PCBs were the only contaminant of concern at the CB/NT Site for which ecological cleanup goals would not be sufficiently protective of human health. For this reason, PCBs have been segregated from other contaminants of concern. (See Section 7.1 of the CB/NT ROD, where discussion of human health risks is presented.) Further discussion of this issue is presented in response to comments in Section 4.6.

*2.2.4 The PCB SQO was established by a human health risk assessment, which was thought to be a more sensitive endpoint than an ecological endpoint at the time of the Record of Decision. While the dose response curve for human cancer posed by PCB's cancer risk posed by PCB to humans may be lower than previously thought, new studies are showing greater effects to fish and wildlife than was previously known. (24)*

**Response**: EPA agrees that it would be beneficial to check the assumption in the ROD that a PCB sediment cleanup level based on human health would also protect wildlife. An evaluation of the threats to wildlife from exposure to contaminated prey or sediment was performed by EPA as part of the Addendum (Weston, 1997a). The results were used to ensure that the selection of a PCB cleanup level based on protection of human health would also be protective of wildlife.

*2.2.5 It has recently been discovered that the toxicity of PCBs is not related to the degree of chlorination. (17)*

**Response**: EPA disagrees. In the support document that summarizes the calculation of the new cancer slope factors for PCBs (EPA, 1996a), different slope factors are to be used depending on both route of exposure and percent of chlorination. For example, the lowest upper-bound slope factor of 0.07 per mg/kg-day is to be used only when analyses verify that congeners with more than four chlorines comprise less than 1/2 percent of total PCBs. Route of exposure is considered because of the expected partitioning of more highly chlorinated congeners in certain media (e.g., fish, sediment, soils). As recommended by this document, the highest slope factor of 2.0 was used in the Addendum (Weston, 1997a) since the route of exposure assumed for all exposure scenarios was fish consumption.

*2.2.6 The Puyallup Tribe of Indians has not been recognized as a sovereign Indian nation with governmental and proprietary interests in this matter, not limited to its treaty resources, which have been seriously impacted by the release of hazardous substances including PCBs into Commencement Bay. EPA's risk assessment fails to acknowledge the well documented tribe's concerns; does not meet the legal requirements that provide for permanent cleanup of the Hylebos Waterway; ignores EPA's obligations under its Environmental Justice mandate and the protection of human health and the environment as demanded by Superfund. (29)*

**Response**: EPA agrees that the Evaluation of Residual Risks (Weston, 1996) did not fully address some of the Tribe's concerns. EPA's Environmental Justice guidelines require consideration of populations who may have disproportionately higher exposures to contaminants in Superfund risk assessments and in Superfund cleanup decisions. For these reasons, and because EPA believes it represents a realistic future use scenario for the site, EPA updated the human health risk assessment in the Addendum (Weston, 1997a) to evaluate residual risks after cleanup using high-end tribal fishing as the reasonable maximum exposure scenario.

As to legal requirements for permanent cleanup, the Superfund law does state a preference for treatment to permanently and significantly reduce the volume, toxicity, and mobility of hazardous substances, pollutants, and contaminants. However, EPA determined in the 1989 CB/NT ROD that the nature of the contamination at the CB/NT site (i.e., widespread, low-level contamination) limits the feasibility of treatment options. Confinement was therefore selected as the appropriate remedial action for

CB/NT sediments with higher contaminant concentrations, and natural recovery for sediments with moderate to low contaminant concentrations. EPA's reevaluation of the PCB cleanup level does not change this fundamental aspect of the remedy EPA selected in 1989.

**Part II—Responses to Comments Received Subsequent to Issuance of the Draft ESD**

*NOTE: These comments relate primarily to two documents: the Public Review Draft Explanation of Significant Differences (EPA, 1997a), and the Addendum to the Evaluation of Residual Risks (Weston, 1997a), which included an ecological evaluation as an appendix.*

## 3 Comments Related to the Proposed PCB Cleanup Level

### 3.1 Comments in support of the proposed PCB cleanup level

*3.1.1 We support the EPA's proposal to modify the PCB cleanup level from 150 μg/kg to be achieved within ten years to 450 μg/kg to be achieved immediately after cleanup. (5, 10, 19, 22, 23, 20)*

**Response**: Comment acknowledged.

*3.1.2 While we believe that the 450 μg/kg level proposed by EPA is significantly below PCB cleanup standards set at other sediment Superfund sites, the level is more realistic and reflective of current science than the 150 μg/kg level contained in the 1989 Record of Decision. We also believe that any level lower than 450 μg/kg would seriously compromise the ability of the parties at the various waterways to take advantage of combined disposal opportunities. The volume of sediment which may have to be removed from the larger waterways in order to meet an unrealistic level of 150 μg/kg could far exceed the available capacity at the various disposal sites currently being considered by the parties in conjunction with the Sediment Disposal Site Forum, thus eliminating the possibility of a combined disposal site and/or necessitating additional sites to accommodate excess volumes. (23)*

**Response**: Foremost among all considerations in making a cleanup decision, EPA focused on establishing a PCB cleanup level that would be protective of human health and the environment. As discussed in response to comments in Section 5.2, EPA establishes cleanup levels on a site-specific basis. As discussed in the ESD, in assessing the implementability, short-term effectiveness, and cost of various alternative cleanup levels, EPA considered the volumes of sediment to be removed to achieve the potential cleanup levels. EPA also considered the disposal options associated with containing these volumes of sediment in its reevaluation of PCB cleanup levels at the CB/NT Site.

### 3.2 Comments recommending a higher PCB cleanup level

*3.2.1 The 150 μg/kg PCB number should be modified to be consistent with all other similar Superfund sediment sites—recent PCB cleanup standards have been set at 1,000 μg/kg. The 450 μg/kg PCB cleanup standard would be the most rigorous cleanup standard ever required of any similar Superfund site in the U.S. Even at 600 μg/kg, the standard would be the toughest in the nation for such sites. (6, 18)*

> **Response**: As discussed in response to Comment 2.1.2, EPA's cleanup decisions are made on a site-specific basis and must be protective of human health and the environment at the given site. EPA selected the 450 μg/kg PCB cleanup standard because it is protective of human health and the environment, and provides the best balance of cost, long-term effectiveness and short-term effectiveness. Cleaning up to 600 μg/kg PCBs or higher will be less protective of human health and the environment, will provide less long-term effectiveness, and will result in only a small decrease in the cost of the cleanup. For further discussion, see response to comment 3.2.2.

*3.2.2 The human health risk estimates based on a PCB cleanup level of 600 μg/kg range from 2.75 x $10^{-5}$ to 2.1 x $10^{-4}$ (Weston, 1997a). Table 2 in the Addendum (Weston, 1997a) shows that there is little difference in the 450 μg/kg and 600 μg/kg cleanup levels based on residual risk estimates. EPA's explanation for the acceptability of 450 μg/kg as a cleanup level (Weston, 1997a, p.11) also applies to higher cleanup levels provided that the residual risks do not substantially exceed 1 x $10^{-4}$. The highest estimated residual risk (High-End Recreational Fisher), based on a PCBs cleanup level of 600 μg/kg, is 2.1 x $10^{-4}$. This estimated residual risk is not substantially greater than 1 x $10^{-4}$. Given EPA's rationale for the acceptability of 450 μg/kg, a PCBs cleanup level of 600 μg/kg would cut down on cost from the proposed 450 μg/kg cleanup level, and would still meet the criterion for protectiveness. (1, 6, 18, 9, 17, 19, 23, 25, 30, 13, 17)*

> **Response**: Because EPA assumes that there is no threshold below which carcinogenic effects of PCBs will not occur, EPA strives to minimize this risk to the extent possible. In selecting the 450 μg/kg PCB SRAL, EPA considered other potential cleanup levels, including a 600 μg/kg cleanup level. Potential cleanup levels from 300 μg/kg to 600 μg/kg cleanup level fall at the high end of a range of values which EPA considers protective of human health and the environment, based on a tribal fishing scenario, and which offer similar benefits in protectiveness.
>
> EPA's goal in the Superfund program is to select remedies which reduce human health cancer risks associated with exposure to site contaminants to $10^{-4}$ to $10^{-6}$ or below. EPA chooses cleanup levels that will achieve reduction of risks to within this range, accounting for the uncertainties associated with calculated risk estimates. EPA selected the 450 μg/kg PCB SRAL because it is protective of human health and the environment, and provides the best balance of cost, long-term effectiveness and short-term effectiveness. Because the cost difference between the 450 μg/kg cleanup level and the 300 μg/kg cleanup level is very large (about $13 million, a 72 percent increase in cost), EPA determined that the small environmental benefits to be achieved by going

to the lower cleanup level were outweighed by the cost. However, EPA has added a requirement that PCB concentrations be reduced to 300 μg/kg within 10 years of completion of the remedy. Adding the 300 μg/kg PCB SQO provides additional protectiveness and adds only a small cost to the remedy (for natural recovery modeling and monitoring, and potentially for additional remedial action if models have incorrectly predicted natural recovery rates).

EPA also considered whether a 600 μg/kg cleanup level was appropriate. The cost difference between achieving a 450 μg/kg cleanup level versus a 600 μg/kg cleanup level is about $2.5 million, or a 16 percent increase in the cost of the Hylebos Waterway cleanup. EPA determined that, as with the 300 μg/kg SQO, the relatively small increase in cost was justified to achieve an incremental increase in environmental benefit, especially considering the uncertainties associated with estimates of the toxicity of PCBs (see response to Comment 4.3.3).

*3.2.3 Reducing the volume to be dredged not only is more cost effective, but also is less disruptive to existing aquatic life. Also, this reduces the volume of the disposal site material which must be managed long term. Therefore, since both the 450 μg/kg and the 600 μg/kg cleanup levels are protective of human health and the environment, 600 μg/kg is a better choice. (9)*

**Response**: As part of its reevaluation of the PCB cleanup level, EPA considered cost, short-term effectiveness, and long-term effectiveness. Under the short-term effectiveness criterion, EPA considered the potential detrimental effects to aquatic life associated with cleanup to a range of different potential cleanup levels. EPA concluded that cleanup of sediments to 450 μg/kg provides sufficient additional protectiveness and long-term effectiveness over cleanup to 600 μg/kg to justify a small increase in cost and disruption to aquatic life during dredging.

*3.2.4 There is a tremendous cost savings if the cleanup level is set at 450 to 600 μg/kg because there will be a reduction in the volume of sediment that must be remediated. While cost savings alone should not determine human health risks, where the scientific data supports a modification which will result in a savings of millions of dollars, we believe a compelling case is made for the modification. In fact, the arithmetic mean baywide residual concentration of PCBs, following a 600 μg/kg cleanup, is 82 μg/kg compared to 75 μg/kg for a PCB cleanup of 450 μg/kg, an insignificant difference. That's only a seven part per billion change in PCB concentration for a cost of about 3 million dollars. (19, 17, 18)*

**Response**: EPA considered the difference in cleanup volumes necessary to achieve each of the potential PCB cleanup levels in its reevaluation. As discussed in response to Comment 3.2.2, EPA considered the costs and benefits of selecting a 450 μg/kg versus a 600 μg/kg PCB cleanup level for the CB/NT site and determined that 450 μg/kg offered better protection of human health and the environment with only a small incremental increase in cost.

*3.2.5 The difference in residual PCB sediment concentrations between cleaning up to 450 μg/kg and cleanup up to 1,000 μg/kg is insignificant, 1,000 μg/kg is a protective level, and it would be more cost-effective to cleanup to 1,000 μg/kg. (6, 18, 7, 27)*

**Response**: While EPA did not include a potential 1,000 μg/kg PCB cleanup level in its analysis, EPA did consider a 900 μg/kg PCB cleanup level, which would give roughly similar results as a 1,000 μg/kg cleanup level. Because there are few areas of Hylebos Waterway sediments contaminated with PCBs at concentrations between 450 and 900 μg/kg, the cost difference to go from a 450 to a 900 μg/kg PCB cleanup level is not large, about $4 million. This represents a 29 percent cost increase to achieve a 450 μg/kg cleanup level as opposed to a 900 μg/kg cleanup level. EPA determined that in this case the relatively small increase in cost was justified to achieve an incremental increase in environmental benefit, especially considering the uncertainties associated with risk estimates for PCBs. See EPA's response to Comment 3.2.2 for further discussion.

## 3.3 Comments recommending a lower PCB cleanup level

*3.3.1 The proposed 450 μg/kg cleanup level overprioritizes cost issues and would not be protective of human health and the environment. (28, 11, 29, 35, 36, 9, 9)*

**Response**: EPA is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; Superfund) to select remedies for Superfund cleanups that are protective of human health and the environment. EPA must also select cost-effective response actions for Superfund cleanups. A remedial alternative is considered "cost-effective" if its costs are proportional to its overall effectiveness. Overall effectiveness is determined by evaluating its short- and long-term effectiveness. In this case, the alternative PCB cleanup levels evaluated showed only a small difference in short-term and long-term effectiveness and environmental benefit, but a large difference in cost. Therefore, cost became a significant factor in EPA's decision. EPA believes that its decision to require a 450 μg/kg SRAL, to be achieved at the time of dredging, and a 300 μg/kg SQO, to be achieved within 10 years of completion of the cleanup, is protective of human health and the environment, and meets the CERCLA criterion for cost-effectiveness.

*3.3.2 EPA should be more protective, not less protective, of human health and the environment, and therefore, should not raise the cleanup level. (9)*

**Response**: EPA agrees that it should be as protective as possible in selecting cleanup levels for Superfund response actions. However, EPA is also required under CERCLA to select cost-effective cleanups, and to ensure that significant environmental protection is achieved for every dollar spent for cleanup. In this case, new information since the 1989 ROD indicates that remediation to the original cleanup level will involve a substantially larger amount of sediments than originally anticipated, along with significantly increased costs. In addition, new information about the risks associated with PCBs prompted EPA to reevaluate the original PCB cleanup level. After considering this new information, EPA determined that remediation to an alternative cleanup level would be considerably less expensive, with only a small increase in risk when compared to the cleanup level in the 1989 ROD. The new cleanup levels are, however, still within EPA's acceptable risk range for Superfund cleanups.

*3.3.3 EPA should cleanup PCBs in Commencement Bay sediment to the area background PCB sediment level. (9)*

**Response**: CERCLA requires that Superfund cleanups be protective of human health and the environment. In some circumstances, it is necessary to achieve background concentrations to be protective. In this case, EPA believes protectiveness can be achieved at concentrations above background. Estimates of area background PCB concentrations in sediments range from 20 to 50 $\mu$g/kg in Puget Sound. The average PCB concentration in CB/NT sediments after cleanup will be 75 $\mu$g/kg immediately after cleanup and will be reduced to 63 $\mu$g/kg or lower within 10 years after the cleanup. PCB concentrations at the CB/NT site will be somewhat higher than background after cleanup, but will still be protective.

*3.3.4 EPA's Fact Sheet states that the proposed change in the PCB cleanup levels would have a <u>significant effect</u> only in the Hylebos Waterway cleanup. The Hylebos Waterway completes the drainage for Hylebos Creek, which connects the Bay with sensitive wetlands and uplands throughout the watershed. As such the Hylebos Waterway should be treated with greater concern than the transportation channels formed by other waterways, not sacrificed to the "average" health of the Bay. (28)*

**Response**: EPA agrees that the ecological health of the Hylebos Waterway should be preserved and protected. By stating that the proposed change in the PCB cleanup level would have a significant effect only on the Hylebos Waterway, EPA meant that it focused the cost analysis on the Hylebos Waterway, because the PCB cleanup level has little effect on the cost of cleanup of other Commencement Bay waterways. EPA's risk analysis focused on CB/NT Site as a whole, because EPA felt it was reasonable to assume that most fish, birds, and humans would utilize more than one area of the Site. However, EPA includes in its analysis an assessment of the risks to humans and wildlife that reside or consume fish only from Hylebos Waterway, to ensure that by selecting a cleanup level that was protecting the Site as a whole, a cleanup level was not selected that would have a disproportionately large impact to individuals who preferentially utilize the Hylebos Waterway.

# 4 Comments Related to the Risk Evaluations

## 4.1 Comments relating to the residual PCB sediment concentration

*4.1.1 Since dredging for cleanup would likely reach native sediments, using the background value as the replacement value in the calculation of residual sediment concentrations is likely an overestimate because native sediments should have a PCB concentration of zero. It would be more appropriate to use zero, or half the PCB detection limit, or even the PCB detection limit as the replacement value. (9)*

**Response**: Because PCBs have been in use for so long, and because they are so pervasive in the environment, native sediment PCB concentrations at the CB/NT Site are not expected to be zero. EPA used a 20 $\mu$g/kg PCB concentration for native sediments, which is reflective of background concentrations in areas with no local sources of PCBs. It is also in the range of method detection limits for PCBs in sediments (20 to 40 $\mu$g/kg) under the analytical methods used for pre-design sampling.

*4.1.2 The use of the arithmetic mean simply because it is EPA policy is not appropriate if the distribution of PCB concentrations is lognormal. Furthermore, using the arithmetic mean PCB concentration to account for the fact that the more contaminated sediments tend to be located nearshore in the shallow subtidal and intertidal areas where many fish species or life stages tend to be during flood tides, is flawed. If this is where the most contaminated sediments are located, then this is where the remediation will occur. Therefore, the residual concentrations in this area should be 0 (zero), or at least background. The remaining concentrations will still be lognormally distributed and therefore it is appropriate to use a geometric mean as the basis of the residual concentration. (Whether you use the geometric mean or upper 90 or 95 percentile of the geometric mean is another issue.) (1, 9)*

**Response**: The arithmetic mean was chosen to represent residual sediment concentrations because it was consistent with current EPA policy and because it was thought to be appropriately protective. EPA guidance (EPA, 1992) states that the arithmetic mean is appropriate because it best represents the cumulative intake that would result from long-term contact with site contaminants regardless of the pattern of daily exposures over time or the type of statistical distribution that might best describe the sampling data. In fact, EPA guidance recommends that the 95 percent upper confidence limit of the arithmetic mean be used in risk assessments, because in most environmental sampling, the sample size is too small to accurately reflect the central tendency of the data. In this case, because of the large sample size (over 200 samples for the Hylebos Waterway and over 400 samples for the CB/NT Site as a whole), EPA determined that an arithmetic mean, rather than a 95 percent upper confidence level, is an appropriate concentration term to use in the residual risk assessment.

At the CB/NT Site, while the distribution of PCBs within the sediment of individual waterways tends to form a lognormal distribution, as noted by the commentor, sediments with higher PCB concentrations tend to be located along the banks of the waterways where the fish are likely to spend a disproportionate amount of time. For this reason, the arithmetic mean was chosen as a more protective value. While it is true that the more contaminated sediment will be remediated, sediments with PCB concentrations below the selected cleanup level will remain after cleanup. Because there are relatively higher concentrations of PCBs in the bank areas, residual PCB concentrations after cleanup will be somewhat higher nearer to the banks and in habitat in which the fish may spend more time. Therefore, use of the geometric mean may underestimate actual PCB concentrations to which fish may be exposed. See also EPA's response to Comment 1.2.2.

*4.1.3 It is not clear why EPA sometimes averages residual PCB sediment concentrations based on waterways and sometimes across the entire bay. (8)*

**Response**: Risks were calculated for the overall CB/NT Site and for two individual waterways: the Hylebos and the Thea Foss waterways. While EPA did consider both the CB/NT-wide and the waterway-specific residual risk estimates in its reevaluation of the PCB cleanup level for the CB/NT Site, the CB/NT-wide estimates were used as the primary factor in making risk-based decisions.

*4.1.4 Risks are not associated only with average PCB sediment concentrations, but also with concentrated "hot spots" throughout the bay. Averaging residual sediment concentrations underestimates the impact of localized or hot spot exposures. Exposure point concentrations should not be averaged on a bay-wide or even waterway-wide basis. There is preferential use of habitat and varying site fidelity among species. Averaging residual sediment concentrations underestimates the potential for adverse impacts to fish and wildlife species that exhibit some degree of site fidelity in feeding behavior. (35, 28, 8, 24)*

**Response**: Risks were evaluated for potential exposures following sediment cleanup, not for current conditions. The purpose of the cleanup is to remove PCB "hot spots." After the hot spot cleanup, the remaining PCBs will be at lower concentrations and more evenly distributed in the bay. For this and the reasons discussed in responses to Comments 1.2.2 and 4.1.2, a representative average PCB sediment concentration is appropriate for estimating concentrations of PCBs in fish to which people will be exposed after cleanup. While some fish may be exposed to higher concentrations of PCBs, other fish may be exposed to lower concentrations. Furthermore, fish are mobile, and are exposed to varying concentrations of PCBs as they move throughout or within different areas of the waterways.

The arithmetic mean is also an appropriate representation of residual sediment concentrations with respect to evaluating risks from ecological exposures. In ecological risk assessments, risks to populations and communities of receptors are evaluated, not risks to individual receptors (except in the case of threatened or endangered species). Therefore, while some fish may be exposed to slightly higher concentrations of PCBs due to habitat or site fidelity, other fish will be exposed to lower than average concentrations. As stated above, the arithmetic mean was chosen over the geometric mean to ensure protectiveness while allowing for the possibility that fish might be exposed to elevated concentrations. The arithmetic mean is also appropriate for higher order receptors (e.g., fish-eating birds) for the same reasons that apply to it being protective of human health.

Furthermore, EPA does not believe that using a maximum single-point measurement (as represented by a grab sample) is appropriate to evaluate the risks to wildlife, because very few species (with the exception of sessile benthos) will feed repeatedly at a single point. Most species that exhibit a high degree of site fidelity prey on species that feed over an area.

*4.1.5 The averaging of the cleanup levels in sediment should take into account habitat-specific or habitat-weighted assessment in deriving a protective sediment concentration. (24)*

**Response**: Area-weighting by habitat type is an approach that could be used to calculate residual PCB sediment concentrations. The highest sediment PCB concentrations tend to occur in the intertidal banks and shallow nearshore areas because of proximity to source and sediment transport mechanisms. These areas are also most often used by sensitive taxa or life stages of species of concern. Most of these areas with elevated concentrations are already identified as requiring remediation in both the Thea Foss and Hylebos waterways. The remaining concentration of PCBs has been represented in the reevaluation of risks by the arithmetic mean, which tends to overestimate the actual concentration of these chemicals and is thus conservative with respect to protection of natural resources. See also EPA's response to Comments 1.2.2 and 4.1.2.

*4.1.6 The average sediment PCB concentrations used in the risk calculations over-predict the post-cleanup concentration of PCBs because cleanup of other chemicals will remove additional PCBs (below the target cleanup level) from the Hylebos Waterway. In addition, ongoing natural recovery will further reduce the PCB concentration in sediment. (17)*

**Response**: EPA agrees that cleanup for other chemicals and natural recovery will reduce contaminant concentrations beyond the averages presented in the 1997 Weston report. In the final decision, EPA has incorporated natural recovery by adding a 10-year PCB SQO of 300 $\mu$g/kg. EPA agrees that there will be additional reductions of PCB concentrations through incidental cleanup of PCBs present in cleanup areas for other chemicals. This factor was not included in the 1997 Weston risk assessment because it cannot be quantified until cleanup areas for other chemicals are finalized. Omitting this factor from the quantitative analysis adds an element of conservatism in the calculation of residual risks, which EPA believes is appropriate.

*4.1.7 How can EPA use a "background" concentration of 30 µg/kg PCBs in this process? PCBs are man-made compounds. By definition, there is not a natural background concentration for PCBs and an area background of 30 µg/kg for (southern?) Puget Sound is outrageous! (It is unclear what region of the Sound this background level is defined for since Commencement Bay is in the Central Basin and Carr Inlet, whereas the "background" samples were collected south of the Narrows and therefore in South Sound.) By accepting a background concentration this high it appears that a risk to human health of approximately $10^{-5}$ exists in Puget Sound from PCBs alone! Is this acceptable to EPA? Is EPA planning to remediate the background sample collection site at Carr Inlet or the entire Puget Sound? Please explain the logic that went into accepting this background concentration for PCBs. (9)*

**Response**: While PCBs do not naturally occur in the environment, they are widely distributed throughout world, including Puget Sound. PCBs are no longer produced in the United States, but they are persistent chemicals that have built up in the environment over time. PCBs are widely distributed because of sediment and airborne transport. For this reason, PCBs often appear in non-industrial areas without a direct point source of contamination. These PCBs form what is referred to as "background concentrations." EPA used background concentrations as a basis for comparison to potential PCB concentrations after cleanup, and did not base its cleanup levels on background.

*4.1.8 For what surficial area and depth of sediment are the arithmetic means in Tables 4, 5, and A-1 representative? (1)*

**Response**: The arithmetic means presented in the Addendum (Weston, 1997a) and the ESD (EPA, 1997a) are based on the surface areas of the entire Hylebos Waterway, the entire Thea Foss/Wheeler-Osgood waterways, and the overall CB/NT Site, which includes all waterways and the adjacent area of Commencement Bay out to the 60-foot bathymetric contour. (See Figure 1 in the ESD.) Surface samples represent depths up to 0.3 foot. Surface sample concentrations will be used to evaluate the need for remediation of a given area. Remediation depths are anticipated to be determined by the depth to reach native sediment. Based on existing data, this depth is anticipated to average approximately 7 feet in the Hylebos and roughly 6 feet in the Thea Foss Waterway. (See also response to Comment 4.1.10.)

*4.1.9 Is not the great majority of the PCB exposure to fish from the surface (top layer) of the sediments and the resident benthic organisms? If yes, what is the purpose of targeting the cleanup level "at all points," i.e., at all depths? (1)*

**Response**: EPA agrees that the primary exposure to contaminated sediments by aquatic organisms occurs at the surface layer. Cleanup decisions will be based on PCB concentrations in surface sediment, not concentrations at all depths. At the CB/NT Site, it has been found that contaminants generally reside in the unconsolidated sediments which lie above the native sediments (i.e., sediments which have accumulated since the waterway was last dredged), and that native sediments contain only low concentrations of contaminants. Therefore, dredging depths were determined based on the depths necessary to reach native sediment. Average residual PCB sediment concentrations were calculated from surface PCB sediment concentrations expected to remain at each sampling station after cleanup.

*4.1.10 What PCB Aroclors are present? Nowhere in the ROD or ESD are PCB Aroclors identified. (1)*

**Response**: The most prevalent aroclors present at the CB/NT Site are Aroclor 1254 and Aroclor 1260. Aroclor 1242 was also detected.

*4.1.11 Many of the people who fish and harvest in the bay consume greater than average quantities of fish and shellfish than the general population. Therefore, use of average residual sediment concentrations may underestimate the exposure to PCBs from the bay. (35, 28, 8)*

**Response:** EPA acknowledges that some individuals who fish at the CB/NT Site consume greater than average amounts of fish. Therefore, EPA is using a high-end tribal fishing scenario for decision-making purposes. Residual sediment concentration is only one parameter used to calculate residual risks. Examples of other parameters include the amount of fish consumed, the fraction of fish consumed that comes from the CB/NT area, and the duration of exposure. As discussed in response to Comment 4.2.2, EPA develops a reasonable maximum exposure scenarios for Superfund risk assessments as a mix of average and upper end parameter values that best represents some of the most highly exposed individuals at the Site. For this reason, EPA felt that use of an average residual sediment concentration was appropriate and protective. (Also, see responses to Comments 1.2.2 and 4.1.2.)

## 4.2 Comments Relating to human exposure factors

*4.2.1 Subsistence fishing is a main source of food for many residents in the area and can be witnessed on any weekend at the floating dock in the Thea Foss Waterway. Many of the fishing community are low income and rely on fish and shellfish for a substantial part of their diet. Those for whom subsistence fishing is a main source of food are much more vulnerable. (3, 8).*

**Response**: EPA recognizes that fish from the CB/NT Site may currently or in the future provide a substantial part of some individuals' diets, even though local health authorities have posted signs warning against consumption of fish from the CB/NT Site. EPA has no information on the number of subsistence fishers currently utilizing the CB/NT Site or on their fish consumption rates. Instead, EPA used information from recent studies (Toy et al., 1996) of fish consumption by Puget Sound Native American tribes to develop a "high-end tribal fisher" (i.e., a tribal fisher who consumes a higher than average amount of fish) fish consumption rate of 123 grams/day. EPA believes that in the absence of subsistence fishing data, the high-end tribal fisher estimate provides a reasonable representation of the type of consumption rates that might be seen in a subsistence population. For this reason, the fish consumption exposure scenario has formed the basis of EPA's PCB risk reevaluations for the CB/NT Site. In the Addendum (Weston, 1997a), risks are estimated for both average and high-end recreational and average and high-end tribal fishers.

*4.2.2 The 95th percentile ingestion rate reported the Toy et al. (1996) should have been used to represent the fish ingestion rate of the high-end tribal fisher. Use of the 90th percentile is inconsistent with other Region X risk assessments (e.g., EPA, Ecological Risk Assessment and Seafood Screening Risk Assessment Asarco Sediment Site, October 1996) and will likely result in an under estimation of subsistence angler's fish consumption. A high-end exposure rate of 292 grams per day (about 10 ounces per day) should be used to calculate the predicted cancer risk rates. EPA used a fish consumption rate of 123 grams per day. (8, 26, 36)*

**Response**: The choice of the 95th or the 90th percentile fish consumption rate must be made on a site-by-site basis in order to best represent site-specific exposures. EPA guidance directs that to calculate risks based on a reasonable maximum exposure (RME), a combination of average and high-end values for exposure parameters be used to estimate exposures. Such a combination is expected to result in an RME that is a realistic representation of risks to individuals with some of the highest exposures (90th to 95th percentile) at the Site. Therefore, it is not necessary to use the highest values available for all parameters to establish the RME scenario. For the CB/NT Site, it was determined that in combination with other parameters, the 90th percentile ingestion rate would be a realistic and protective value to represent some of the most highly exposed tribal fishers at the Site.

In the Screening Risk Assessment done for fish consumption at the Asarco site, a range of fish consumption values (from 1 gram of fish per day to 292 grams of fish per day) was used. The highest value (292 grams per day) was based on the 95th percentile consumption rates for the Squaxin Island Tribe in the draft version of the Toy *et al.* study. The 95th percentile ingestion rates in the final Toy study are lower than those in the draft, but somewhat higher than those used in the CB/NT PCB residual risk evaluation. EPA chose to use the 90th rather than the 95th percentile ingestion rate for the reasons discussed above.

*4.2.3 In the calculation of risk to people consuming fish from the Hylebos Waterway, the assumption that 100 percent of fish consumed from Commencement Bay came from the Hylebos Waterway is an overestimate. The Hylebos Waterway is not a prime fishing area and studies indicate that the fraction of fish caught in the Hylebos is no more than 5 percent of the total caught in Commencement Bay (Pierce et al., 1981). (17)*

**Response**: EPA is primarily using the CB/NT-wide human health risk calculations, not the Hylebos Waterway scenario, for decision-making purposes. The Hylebos

Waterway scenario was developed only as a check to ensure that a cleanup level based on the CB/NT risk evaluation would not result in an unacceptable risk to someone who did obtain a large amount of fish from the Hylebos Waterway. Furthermore, EPA evaluates potential cleanup levels using both current and potential future use scenarios for a site. For this reason it is not sufficient to decide whether or not to evaluate a scenario based solely on data collected in 1981.

*4.2.4 Data demonstrate that there can be up to 90 percent PCB losses during frying of fish (Landolt et al., 1987) and frying is the most common preparation method. Yet, in the risk calculations, it was assumed that 100 percent of PCBs remained in the fish. (17)*

**Response**: See response to Comment 1.1.8.

## 4.3 Comments related to the toxicity of PCBs to people

*4.3.1 As a practical matter, it is incongruous to accept a decrease in the PCB toxicity factor from 7.7 to 2.0 without making a corresponding change in magnitude to the cleanup level. (25, 30, 13)*

**Response**: As noted in response to Comment 1.1.2, in order to best represent the most current EPA policies and most current scientific data, all parameter values used to calculate risks were reevaluated. The PCB toxicity factor is not the only input parameter value to be updated since the ROD (see parameter values used in the Addendum [Weston, 1997a]). Therefore, the resulting change to risk estimates, and consequently, to the proposed PCB cleanup level, is not solely proportional to the change in the PCB toxicity factor.

*4.3.2 The cancer-based human health risk assessment does not acknowledge or address the wide range of non-cancer health effects associated with PCBs. (3, 36)*

**Response**: In the human health risk assessment done for Commencement Bay in 1985, the potential for both cancer and non-cancer health effects from exposures to PCBs in fish from the Bay was evaluated. Based on the information available on the toxicity of PCBs at that time, it was concluded that the potential for non-cancer impacts was not of concern. Therefore, when the ROD was written in 1989, EPA based its cleanup level for PCBs on human health cancer risks from ingestion of PCB-contaminated fish caught in the Bay.

Similarly, in the updated risk evaluations (Weston 1996, 1997a,b), EPA focused on cancer risks associated with PCBs, and updated non-cancer risk information was not presented in these reports. In response to comments EPA received on the Weston report, EPA has prepared a technical memorandum which provides information regarding non-cancer risks under current and post-cleanup conditions using the scenarios developed for the cancer risk evaluation. This technical memorandum has been added to the Administrative Record for EPA's final decision (Weston, 1997b). A summary is provided below.

Based upon an understanding of the development of non-cancer health effects, potential non-cancer impacts are evaluated by EPA assuming that there is a level of exposure below which health impacts are unlikely to occur. The estimate of this level of exposure is called the reference dose, or RfD, and is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." Exposures that are less than the RfD are not likely to be associated with adverse health impacts. (See the response to Comment 4.3.3 for more information on the RfD for PCBs that was used to estimate non-cancer health impacts.)

In order to calculate non-cancer risks for site-specific risk assessments, EPA compares the RfD to the exposures estimated for that site (e.g., from eating contaminated fish). This comparison, called the Hazard Quotient or HQ, is the ratio between the estimated site exposure and the RfD. As with cancer risk, the assumptions used in calculating the HQ are conservative ones (health protective) to ensure that remedial decisions based upon them will protect more sensitive individuals. Because of the way in which the HQ is derived, it should not, however, be viewed as a strict demarcation between toxic and nontoxic.

Results of this non-cancer risk evaluation show that, as for cancer risks, current conditions in the CB/NT Site are of concern for people who may be eating large amounts of fish from the Site. Under current conditions for the high-end tribal fisher, the HQ is 60. Under the 450 $\mu$g/kg PCB cleanup level, the HQ would be reduced to 8 immediately after cleanup and to 7 in 10 years after cleanup. Under the 150 $\mu$g/kg PCB cleanup level in the 1989 ROD, the HQ would be reduced to 7 immediately after cleanup and to 6 in 10 years after cleanup. For an average tribal fisher, these HQs would be reduced by a factor of 3. Both the cleanup required under the 1989 ROD and in the ESD (EPA, 1997a) provide for substantial reduction in the non-cancer risks associated with PCBs in sediments at the CB/NT Site. As with cancer risks, given the range of uncertainty in risk calculations, these post-cleanup HQs are not significantly different. Therefore, as with cancer risks, EPA does not believe that the 450 $\mu$g/kg PCB cleanup level provides significantly different non-cancer risks than the PCB cleanup level presented in the 1989 ROD.

It should be noted that HQ values above 1 do not mean that non-cancer health impacts will occur, but rather that the potential for such impacts increases as 1 is exceeded. The potential for impacts depends on a number of factors, including the protectiveness of both the RfD and the exposure assumptions used to calculate the HQ. As described in the response to Comment 4.3.3, the derivation of the RfD for PCBs is based upon a large body of experimental data and incorporates a several-hundred-fold uncertainty factor ("safety"-factor) to ensure protection. Also, the exposure assumptions used in the CB/NT risk evaluation were selected to be protective for a consumer of large amounts of fish from the CB/NT Site over a 30-year period. Given these conservative assumptions, the small increases above an HQ of 1 estimated for the various target cleanup levels and for background suggest a low potential for non-cancer impacts for the fish consumers considered in the calculations. Individuals who eat less fish from the CB/NT Site will have exposures and HQs that are lower and, therefore, their potential for non-cancer impacts will be less.

*4.3.3 EPA's Reference Dose (RfD) does not acknowledge or address the wide range of non-cancer health effects associated with PCBs including impacts on the immune system; reproductive and developmental system (miscarriages, impaired testicular descent, genital deformities, and other general impairments in reproductive and sexual development); neurological system (lowered intelligence, behavioral problems); and endocrine system (including hormone mediated cancers and the human breast cancer connection) and the fact that embryos, fetuses and young children are at much greater risk than adults particularly with respect to the hormone disruption impacts of PCBs. (8, 26, 36)*

**Response**: In developing the RfD for a specific chemical, EPA scientists review all of the non-cancer studies on that chemical, including those done on experimental animals and those done on humans that have been exposed to the chemical. Experimental animal data are often from experiments performed on different species and at different exposures. From these data, the study showing the toxic effect at the lowest level of exposure is chosen as the "critical study." The level in this study at which no effect was seen (or the lowest level, if effects were seen at all exposure levels) is then selected and uncertainty factors are applied to this level to account for uncertainties in the database (e.g., in using animal data) and to protect sensitive individuals (e.g., the fetus, children, asthmatics).

The EPA RfD used for calculating the HQs (Hazard Quotients) discussed in Comment 4.3.2, is the RfD for Aroclor 1254 (an industrial mixture of PCBs) (EPA, 1997b) since this was the mixture that most closely approximated the PCBs present in CB/NT sediments. EPA published this RfD in 1994. In developing this RfD, scientists from several EPA offices reviewed all of the published (and some unpublished) literature (over 90 studies) on the non-cancer effects of PCBs. These included studies that were conducted on several species of experimental animals as well as studies on human populations that had been exposed to PCBs. The types of effects studied in experimental animals ranged from very obvious toxicity (e.g., death, reduced survival, obvious reproductive effects like gross abnormalities and reduced litter size, and organ damage) seen at higher exposures to PCBs to those that are more subtle (e.g., immunological effects and impacts on blood chemistry) and which can occur at lower exposures. The exposure levels in the animal studies ranged from those as low as 5 $\mu$g/kg-day (micrograms per kilogram per day) to those that were thousands of times higher. The number of human studies available and the types of effects studied were less than that for experimental animals, but both obvious and more subtle toxicological effects resulting from occupational and accidental exposures were reviewed.

The data chosen to develop the RfD (the "critical study") was a series of studies on rhesus monkeys that had ingested PCBs for five years at levels as low as 5 $\mu$g/kg-day (the lowest level of exposure studied in animals) (Arnold *et al.*, 1993a, 1993b; Tryphonas *et al.*, 1989, 1991a, 1991b). A battery of effects was studied including impacts on general health, blood chemistry, the immune system, reproductive endocrinology, and hormone levels. This study was chosen for the RfD because it was technically sound and it showed effects at the lowest dose of PCBs tested. These effects included inflammation of the eyelid glands and eye discharge; changes in the fingers and toenails such as elevated nail beds and abnormal nail foldings; and an inability of the immune system to respond. A "safety" or uncertainty factor of 300 was applied to the lowest effect level seen in this study (5 $\mu$g/kg-day) to account for several uncertainties, including extrapolating from monkeys to humans, to protect sensitive individuals in the human population, and to account for the use of data where the lowest effect (rather than no effect) had occurred. Therefore, the final RfD of 0.02 $\mu$g/kg-day is at a level that is 300 times lower than the level at which an effect was seen.

At the lowest levels tested, this study did not show effects on the menstrual cycle or on estrogen levels. Effects on reproduction and on the offspring of these monkeys has not yet been published but a preliminary review of the unpublished data by EPA indicated that there may be reproductive effects at the lowest level tested. This is in contrast to another study done on rhesus monkeys (Levinskas *et al.*, 1984) which showed no reproductive effect at the 5 $\mu$g/kg-day level. The Levinskas study included evaluations of the exposed adults as well as the offspring of these adults. In both the adults and their offspring, in addition to clinical analyses of toxicity (e.g., skin and eye problems), studies were done on blood and urine chemistry. The adults were also studied for male reproductive effects and female conception rates. This study found no effect at the 5 $\mu$g/kg-day exposure level.

It should be noted that potential adverse impacts on several of the organ systems mentioned by the commentors as being of concern for PCBs were looked for in the animal studies done on PCBs and were considered in the development of the 1994 RfD. Effects on some of these systems were not observed seen until exposures exceeded that used in developing the RfD (the lowest effect level); therefore, the RfD is expected to be protective for these effects that are occurring at higher exposure levels.

Some commentors stated that EPA was ignoring several studies of non-cancer health impacts in humans. In developing the RfD, EPA reviewed the available human data on the non-cancer effects of PCBs, but concluded that these data were only useful in a qualitative manner. Studies have been done on the general population who were exposed to PCBs via consumption of contaminated food (e.g., fish). Infants have been evaluated for impacts on the nervous system and on behavior after being exposed in the uterus or through breast feeding. However, the types of PCBs to which these populations were exposed, the levels of PCB exposure, the levels of exposure to other contaminants (e.g., in fish and breast milk), and other details of exposure are not known, making it very difficult to use these data to calculate an RfD. This is also true for studies of workers exposed to PCBs. Although the majority of the human studies of toxic effects of PCBs is from occupational exposures, these data are insufficient to develop an RfD due to lack of information on the levels of PCB exposure and concurrent exposures to other chemicals.

Some commentors criticized EPA for not considering endocrine-disrupting effects in the development of its RfD. An endocrine disrupter is an agent that interferes in some way with the natural hormones in the body (e.g., those secreted by the pituitary, thyroid, pancreas, adrenal, testes and ovaries). An agent might disrupt the endocrine system by affecting any of the various stages of hormone production and activity. A variety of chemicals, including PCBs, have been found to cause endocrine disruption in laboratory studies, including disruption of female and male reproductive function (such as sperm production, ability to conceive) and effects on the thyroid gland, which helps maintain normal metabolism. It should be noted that several of the experimental animal studies reviewed in developing the RfD for PCBs looked for these types of effects. Also, some of the human endocrine disrupter data cited by the commentors as not being considered by EPA in its RfD development (e.g., neurobehavioral effects in children) were reviewed for the RfD. As discussed above, these studies could only be used in a qualitative manner.

Since the development of the RfD in 1994, there has been additional research done on endocrine disruptors. A review of all of the research on endocrine disruptors, including this newest data, was completed by EPA's Risk Assessment Forum in February of 1997 (EPA, 1997c). In its report on this review, EPA concluded that, with few exceptions, a causal relationship between exposure to a specific environmental agent and an adverse health effect in humans operating via endocrine disruption has not been established. Exceptions are incidents of high chemical exposures in the workplace and exposure to the drug, DES. For example, conclusive evidence linking environmental exposure to endocrine disruptors with infertility or cancers of the breast or prostrate (all mentioned by the commentors) is not available at this time.

The 1997 report also recognized that there is concern about the possibilities of impacts to human health due to exposure to endocrine disruptors, including the potential risk to the developing young who may be at more risk than adults (as mentioned by the commentors), and that more research into this area and into other areas mentioned by the commentors needs to be done. EPA is preparing a draft research policy on endocrine disruptors that will be released later this year. EPA has also established a task force to develop screening and testing methods for use in evaluating chemicals for endocrine effects. Efforts are underway to coordinate endocrine disrupter research throughout the federal government.

Finally, EPA will soon complete a reassessment on the toxicity of and exposures to chlorinated dioxins and furans, as well as dioxin-like PCBs. Dioxin-like PCBs are those PCBs having a chemical configuration similar to chlorinated dioxins and furans, and which are, therefore, thought to act in a toxicologically similar fashion to dioxins and furans. The results of the review of existing data and the new data generated by this reassessment could have an impact on the way in which non-cancer impacts from this specific group of PCBs are evaluated.

The results of the research efforts described above will be used by EPA scientists to determine whether a modification to the PCB RfD is necessary. If EPA decides to significantly modify the RfD for PCBs, it may be necessary for EPA to reevaluate cleanup decisions made at Superfund sites where PCBs are a contaminant of concern to determine whether the cleanups at those sites are still protective of human health and the environment.

*4.3.4 Because of the limited numbers of hormone receptors in developing human embryos and fetuses, the fact that hormones are already operative, and the essential role hormones play in survival and proper development, a strong case can be made that there is no safe level for PCBs. (36)*

**Response**: If by a "safe level," the commentor is referring to a "no adverse effects" level, EPA agrees that this may be the case for many cancer-causing chemicals. Because of the way in which chemicals are thought to cause cancer, EPA assumes that it is not possible to define a level for exposure to a cancer-causing chemical which it is certain will be associated with no effects. Therefore, all exposures are assumed to potentially have some risk associated with them with the risk of developing cancer increasing as the exposure increases. EPA regulations require that Superfund cleanups achieve a reduction in contaminant concentrations such that the chance of developing cancer under a "reasonable maximum exposure" scenario is within the range of $10^{-4}$ to $10^{-6}$.

For the non-cancer effects of a chemical, it is assumed that a "no adverse effects" level of exposure can be determined—this level is defined as the RfD (Reference Dose) by EPA. In developing the RfD for PCBs (discussed in detail in the response to Comment 4.3.3), all of the available non-cancer data on PCBs were considered, including those relating to adverse hormonal impacts.

However, as discussed in its recently released review on endocrine disruptors (see Comment 4.3.3), EPA recognized the need for further research on exposure of neonates and the human fetus to environmental levels of endocrine disruptors and discussed several ongoing efforts to expand and improve upon the research in this area.

The results of this research should provide further information on the question of a safe threshold for non-cancer impacts due to PCBs.

## 4.4 Comments related to ecological exposures to PCBs at the CB/NT Site

*4.4.1 The bioaccumulation model assumes that piscivorous birds (fish-eating birds) obtain all of their prey (forage fish) within the Hylebos Waterway. This assumption overestimates the exposure of migratory birds or birds with large foraging ranges, like the eagle. (17)*

**Response**: EPA primarily used the CB/NT-wide risk estimates, not the Hylebos Waterway risk estimates, for decision-making purposes. The waterway-specific information was used, however, as a check to ensure that a cleanup level was not selected that would have a disproportionately large impact to individuals who preferentially utilize one waterway. EPA believes that this is a reasonable approach based on FWS information indicating that individual birds can demonstrate a high degree of site fidelity in their foraging/hunting activities (Krausmann, 1996). See also EPA's response to Comment 3.3.4.

It should be noted that the primary basis for EPA's decision on the PCB cleanup level was the human health risk evaluation. The wildlife risk evaluations provided in FWS comments (FWS, 1996a,b) and the 1997 Weston report were used only to confirm that the selected PCB cleanup level for protection of human health would also be protective of ecological receptors. It should also be noted that EPA did not use the eagle data provided by FWS for decision-making purposes, due to concerns about the uncertainty associated with the biomagnification factor and the lack of data on foraging ranges.

*4.4.2 The use of BSAF of 1.7 should be reevaluated. Current models and studies in the scientific literature recommend a BSAF of 4. (24)*

**Response**: See response to Comment 1.5.1.

*4.4.3 The use of an average total organic carbon (TOC) value for the various waterways may not be appropriate. The lowest TOC value representative of an area in the waterway should be used to more accurately reflect what a species with site fidelity would be exposed to. (24)*

**Response**: The distribution of total organic carbon represents a gradient of low TOC at the mouth and high TOC at the head in both the Thea Foss and Hylebos waterways. Use of the lowest TOC would reflect only a small portion of the waterway. It is more accurate to represent exposure based on prevailing conditions, which are better represented by the mean TOC for the waterway.

*4.4.4 Fish in Commencement Bay contain high levels of PCBs in their bodies. A recent study by the National Marine Fisheries Service (NMFS) in the Hylebos Waterway of Commencement Bay links the presence of PCBs to altered sexual reproduction of flatfish. In the studies, half* *of all juvenile female flatfish showed signs of premature sexual development. The same study also revealed levels of PCBs in young salmon found migrating through the Hylebos Waterway were comparable to levels found in other young salmon in the Duwamish River. The Duwamish River study documented impaired growth, suppression of immune function, and increased mortality rates after exposure to pathogens. English and rock sole in the Hylebos Waterway have high rates of liver lesions which are associated with PCBs in their bodies. Despite the passage of 10 to 15 years and some remediation, there has been no real improvement in terms of exposures and injuries for these fish. (8, 26, 36)*

> **Response**: EPA agrees that current conditions are adversely impacting fish in the Hylebos Waterway, which is one of the reasons EPA wants to complete the sediment cleanup as soon as possible. The NMFS studies, however, do not provide information about a PCB cleanup level that would prevent such effects from continuing to occur.

*4.4.5 In the last two years, we have seen an increase in predation on the great blue heron colony by bald eagles. We believe these eagles are at further risk of adverse impacts due to the nature of PCBs bioaccumulating through the food chain. (35)*

> **Response**: Although raptors may represent sensitive receptors, EPA does not have sufficient data to evaluate the risks to these receptors at this time. It is EPA's understanding that FWS is conducting work that would support this evaluation, but that these data are not yet available.

*4.4.6 Fish-eating birds, such as bald eagles and blue herons, in the Commencement Bay area have high levels of PCBs in their embryos. PCB levels in blue heron eggs from Dumas Bay, located near Commencement Bay, are 5 to 10 times higher than the observed level at which negative effects occur. The herons from Dumas Bay use Commencement Bay as their feeding grounds. (8, 26, 36)*

> **Response**: It is EPA's understanding that FWS is conducting work that would support the evaluation of threats to heron and bald eagle, but these data are not yet available. EPA agrees that at current conditions, PCBs in sediments may be adversely affecting piscivorous birds, and may present an imminent and substantial endangerment to wildlife until a cleanup is implemented. EPA has included an evaluation of the potential impacts to piscivorous birds from ingestion of contaminated prey, based on the herring gull data from the Great Lakes, to ensure that the selected PCB cleanup level will be protective of wildlife.

## 4.5 Comments related to the ecological toxicity of PCBs

*4.5.1 We disagree that the range of LOAELs (Lowest Observable Adverse Effects Levels) presented represents a variability of risk, and therefore uncertainty, in the risk assessment. For example, the adverse effects associated with levels of PCBs in the egg of a bald eagle do not increase or decrease the adverse effects observed and associated with the levels of PCBs in the egg of a Caspian tern. The risk assessment calculated hazard quotients for birds based on the "average LOAEL presented by the FWS." (emphasis added). However, the tables presented by the FWS on LOAELs were intended to show the levels of total PCBs associated with adverse effects to specific bird and wildlife species from various published literature sources. Data from this table was not averaged in its original presentation nor was the intent to imply that averaging effects to individual species would be appropriate in an ecological risk assessment designed to determine overall protectiveness for fish and wildlife. Risk should be calculated for the most sensitive of the species of concern if the intent is to be protective of that species. (35)*

> **Response**: EPA agrees that it is important to protect for sensitive species. There was little difference in the lowest observable adverse effects levels (LOAELs) reported for piscivorous bird egg effects (3.5 to 5.0 mg/kg). Use of the LOAEL for the most sensitive species (double-crested cormorant; 3.5 mg/kg) compared to the average (4.2 mg/kg; equivalent to the Caspian tern LOAEL) would have resulted in only a small change in the hazard quotient and would not have changed the overall interpretation of the estimated risk.

*4.5.2 It is well established that PCBs can have significant genetic and reproductive effects to fish and wildlife at low concentrations. Because of the ecological significance of these effects, specifically to the viability of fish and wildlife populations which utilize Commencement Bay, a conservative approach to the ecological evaluation is warranted. (24, 36)*

> **Response**: As noted in response to Comment 4.4.1, EPA's primary basis for decision-making on the PCB cleanup level was the human health risk evaluation. EPA used information about ecological risks presented in the FWS comment letters (FWS, 1996a,b) and the Addendum (Weston, 1997a) to confirm that the PCB level considered protective of human health would also be protective of ecological receptors. As discussed in the response to Comment 1.6.2, EPA has used the information provided by the FWS and NOAA to evaluate the risks to wildlife. EPA used the PCB bioaccumulation models provided by the FWS to address impacts to higher order receptors, such as fish-eating birds that may bioaccumulate PCBs through the food chain, in the evaluation of the potential for impacts to ecological receptors. EPA assumed piscivorous birds were obtaining 100 percent of their diet from the CB/NT Site. EPA also used the arithmetic mean to represent the residual PCB concentration, which, as discussed in responses to Comments 1.2.2, 4.1.2, and 4.1.5, is a conservative representation.

*4.5.3 Using cancer as an end point in the assessment process for PCB's does not account for the true injury to the biota of Commencement Bay and will not be protective of these biota. (29, 36)*

**Response**: EPA agrees. Cancer was not used as the endpoint for evaluation of the risks to wildlife. Rather, EPA evaluated reproductive effects in piscivorous birds, growth and survival in juvenile salmonids, and abundance and diversity of benthic infauna to determine the potential effects to wildlife, under various cleanup scenarios proposed for the protection of human health.

*4.5.4 According to the United States Fish and Wildlife Service and the National Marine Fisheries Service studies, PCBs cause not only increased mortality rates, but several other short-of-fatal but serious problems. These include impaired growth, suppression of immune function and impaired or premature sexual development. The results of the FWS model (FWS, 1996) indicate that by leaving 450 μg/kg of PCBs in the Commencement Bay environment, fish-eating birds could accumulate levels of PCBs 5 to 10 times higher than levels where we would first expect to see adverse reproductive impacts such as embryonic deformities and death. Not only is it unconscionable to knowingly permit such harmful levels to continue, it is simply wrong-headed to believe that humans will escape the effects of such toxic chemical substances. Thirty μg/kg will protect fish-eating birds, so we are assured that even 150 μg/kg is high for fish. (3, 35)*

**Response**: EPA agrees that PCBs in CB/NT sediments at current concentrations may present an imminent and substantial endangerment to a variety of wildlife species and people. EPA agrees that PCBs should not be allowed to remain in CB/NT sediments at current concentrations.

The commentor is correct that FWS has recommended a 30 μg/kg PCB cleanup level to protect fish-eating birds. FWS assumed that after cleanup, fish would reside in areas where they would be exposed to only the maximum PCB concentration remaining in sediments, and that birds would only eat fish that had these high exposures.

EPA's policy is to use a "reasonable maximum exposure" scenario in developing cleanup levels for Superfund sites, which is defined as the highest exposure that is reasonably expected to occur at a site. The area within the CB/NT Site where maximum PCB concentrations (i.e., PCB concentrations at the cleanup level) will occur post-cleanup will be quite small. In the evaluation of the impacts to wildlife at various PCB cleanup levels, EPA assumed that fish would move about within the waterways and be exposed to average PCB concentrations, rather than maximum concentrations. EPA used FWS's estimates to predict the impact to birds eating these fish. Based on EPA's analysis, the impacts to birds and fish at the 450 μg/kg PCB SRAL and 300 μg/kg PCB SQO are not appreciably different than the impacts at the original 150 μg/kg PCB SQO.

*4.5.5 PCBs are one of several chemicals known to disrupt the endocrine systems of birds and mammals. Other studies of PCBs show impaired sexual development in marine life. Small penises in young Columbia River otters have been linked to PCBs in their bodies and these young otters do not appear to be able to produce sperm. (8, 26, 36, 29)*

> **Response**: EPA is also concerned about the potential for PCBs to disrupt endocrine systems, as discussed in the response to Comment 4.3.3.

*4.5.6 The new wildlife criterion for aqueous concentrations of PCBs in the Great Lakes (EPA, 1997) is $1.2 \times 10^{-4}$ ng/mL. This is based on an average log $K_{ow}$ of 6.59. PCBs are expected to partition similarly in freshwater and marine systems. Equilibrium partitioning can be used to predict the sediment concentration that should produce this aqueous concentration. The equation: $[sed]/f_{oc} = K_{oc} * [water]$, is used to predict sediment concentration that will produce the criterion concentration of $1.2 \times 10^{-4}$ ng/mL. Setting $K_{ow} = K_{oc}$, the predicted sediment concentration is 466 ng/g organic carbon. For a TOC of 2.4 percent, the sediment concentration would equal 11.2 ng/g. (24)*

> **Response**: While some PCBs may partition to the water column, chemical properties of PCBs will result in a significantly larger amount remaining in the sediments. Therefore, EPA does not believe it is appropriate to increase the uncertainty associated with the risk estimates by extrapolating to another medium (i.e., water). Furthermore, the approach suggested by the commentor proposes to make additional extrapolations and assumptions (e.g., $K_{ow} = K_{oc}$) that add more layers of uncertainty to the risk estimates. EPA believes the approach utilized in the human health and ecological risk evaluations presented in the Addendum (Weston, 1997a) is a more appropriate evaluation for the conditions present at the CB/NT Site.

### 4.6 Comments Relating to additional exposure to contaminants

*4.6.1 Combinations of chemicals can be far more deadly than PCBs acting alone. Combinations of PCBs and other pollutants can also have much greater effects than the chemicals considered one at a time. PCBs are not the only pollutants in sediment, in animals, in people's daily environments, and in people's fat, food and breast milk. At a minimum, each person carries 250 synthetic pollutants in his or her body. More and more studies have documented that combinations of chemicals can have far worse effects than chemicals in isolation. This proposal does not consider the overall risks due to the synergistic or additive nature of these chemicals with PCBs and their impacts on the natural resources which inhabit this embayment. (36, 29)*

> **Response**: The available scientific data on mixtures (including those of endocrine disruptors) are primarily from laboratory experiments and some occupational studies. These data suggest that exposures to multiple chemicals may result in the following toxicological effects : (1) additivity such that the resulting toxicity is equivalent to the sum of the toxicity of each chemical alone; (2) antagonism such that the resulting

toxicity is less than the sum of each chemical added together; or (3) synergism such that the resulting toxicity is greater than the sum of the each chemical added together. However, the current database is not complete enough to determine which of these effects are occurring from a particular environmental exposure or to quantify these effects. Therefore, EPA's current approach is to assume additivity of effects (EPA, 1986). For this assumption, the combined effects of antagonism and additivity are assumed to balance the possible effects of synergism.

For carcinogenic effects, additivity is assessed in the Superfund program by combining the cancer risks resulting from chemical exposures from the site contaminants. For non-cancer effects, additivity is applied to site-related contaminants that produce their toxicological effect by similar types of actions (e.g., specific impacts on the immune system). As a first step, all of the HQs (see Comment 4.3.2 for a definition of the HQ) are added, and the combined HQ for all contaminants is evaluated.

In the human health risk assessment done for the CB/NT Site in 1985, the potential for both cancer and non-cancer health effects from exposures to contaminants in fish from the Site was evaluated. This evaluation was done using data on contaminant levels in fish tissue collected from several parts of the Site, as well as from Carr Inlet, which was selected as the reference or background site. EPA toxicity values were used with these observed fish contaminant levels and a range of fish ingestion rates (up to 1 pound or 454 grams per day) to estimate potential cancer risks and non-cancer hazards. The mixtures of PCBs present at the CB/NT Site were accounted for in this risk assessment because the toxicity data used and the chemical contaminant data from fish were those for the mixture of PCBs at the Site.

The risk assessment concluded that, for chemicals that are potentially carcinogenic, three of these are present in fish tissue at levels different from the levels in background (Carr Inlet) fish—PCBs, tetrachloroethene, and bis(2-ethylhexyl)phthalate (BEHP). The risks for tetrachloroethene and BEHP were more than an order of magnitude lower than for PCBs. For chemicals with non-cancer effects, it was concluded that only three chemicals were at levels that are slightly above (less than 2 times higher) the Acceptable Daily Intake (ADI) (now called the RfD or Reference Dose by EPA), but that there is essentially no difference in the tissue levels of these three contaminants at the CB/NT Site versus Carr Inlet.

Although additivity of toxicity for these three site-related carcinogens was not explicitly addressed in the risk assessment, the predicted risk values for tetrachloroethene and BEHP are so much lower than those for PCBs, they would not significantly add to the CB/NT Site risk due to PCBs.

As discussed in the response to Comment 4.3.3, new research is being done on endocrine disruptors and dioxin-like PCBs. It is possible that the results of this new research could change the methods EPA currently uses to assess mixtures of PCBs and mixtures of endocrine-disruptors like PCBs.

*4.6.2 PCBs are but one of several classes of chemicals known to disrupt the endocrine systems of fish, wildlife and humans (Colborn, 1993). Other "endocrine-disrupters" such as certain pesticides, heavy metals, and other industrial chemicals are known to exist in various quantities in the CB/NT Site. The current proposal makes no reference to how the proposed changes in the PCB cleanup level will affect overall risk due to the synergistic or additive nature of these other chemicals remaining in the Commencement Bay environment. To date, the FWS has provided the EPA with information concerning the adverse impacts of elevated PCBs on fish and wildlife in Commencement Bay. However, literature suggests that, at the very least, adverse impacts to fish, wildlife and humans may be additive in the presence of other endocrine-disrupting chemicals (Colborn, 1993). (35)*

**Response**: Please see responses to Comments 4.3.3 and 4.6.1.

*4.6.3 I urge EPA to think about the concept of global loads of PCBs in the Commencement Bay decision. Your narrow analysis misses the big picture of a planet which desperately needs your leadership in many different sites concurrently to reduce the overall PCB loadings in the global environment. Many studies have documented that people who live far away from any sources of pollutants have some of the highest levels of these pollutants. Scientists now understand that this is the result of pollutants volatilizing in warmer regions, traveling by air to colder regions, and condensing there. We request that EPA investigate and factor in evaporation and deposition routes of exposure for people living in colder regions where PCBs have been documented to collect via transfer from industrial areas. (36)*

**Response**: EPA agrees studies have shown that PCBs have been transported globally and can be found in remote and non-industrial regions. However, EPA's Superufund regulations require that cleanup decisions be based on potential exposures and health impacts from contaminants from a specific Superfund site. The concept of global loadings is not considered in the Superfund law or regulations. For the CB/NT Site, decisions have been based on protection of those individuals who are expected to have the highest exposure to site contaminants. EPA believes that by selecting cleanup levels that are protective of those living close by the site and who will have the highest potential exposure to site contaminants, (in this case, a tribal fisher who eats a higher than average amount of fish from the site), the selected PCB cleanup level will also be protective of those who live further away and receive a smaller dose through air transport. Because of the low solubility of PCBs, the potential dose of PCBs one might receive from their partitioning from sediments to the water column and then entering the atmosphere from the CB/NT Site is quite small, especially when compared to the dose received by eating PCB-contaminated fish.

*4.6.4 Even if the concept of safe thresholds of PCBs and other pollutants is still valid—a matter in great dispute—fish, people and other animals are so contaminated with PCBs and* *other pollutants already that we have passed those thresholds. Study after study have shown that fish, people and other animals are carrying very significant quantities of these PCBs in our bodies. A risk assessment cannot accurately depict risk if it does not take these levels into account. (36)*

**Response**: EPA recognizes that people may be exposed to a variety of chemicals in everyday life, in addition to potential exposures from a Superfund site. Because each individual will have different exposures based on their occupation, place of residence, and lifestyle, it is difficult to develop a method which accounts for these varied exposures. Instead, EPA's Superfund regulations and guidance focus on the lifetime excess cancer and non-cancer risks from exposure to Superfund site contaminants and bases cleanup decisions on those risks. EPA assumes that receptors do have other exposures than those from the Superfund site, and strives to set Superfund cleanup levels that do not pose an unacceptable additional risk.

PCBs are carcinogenic chemicals, for which EPA does not recognize a "safe" threshold. However, in assessing carcinogenicity to humans, EPA has set a standard that estimated lifetime excess cancer risks on the order of $10^{-4}$ to $10^{-6}$ fall within an acceptable range. EPA evaluates all risks to ecological receptors based on a variety of effects, for which a threshold value is recognized. Risks to ecological receptors are calculated using lowest observed adverse effects levels (LOAELs) or no observed adverse effects levels (NOAELs). Exposures that exceed these thresholds are identified as potential risks.

*4.6.5 With thousands of pollutants in the environment and a minimum of hundreds in each person, how will you account for the myriad of potential combinations of exposure? Will you test each combination? Will you have side calculations in your risk assessments for each possible combination? (36)*

**Response**: See responses to Comments 4.6.1 and 4.6.4.

## 5 Comments Related to Remedial Decision-Making

### 5.1 Comments related to the protectiveness of the proposed PCB cleanup level

*5.1.1 The risk assessment is based on sediment concentrations and, as such, has a higher degree of uncertainty than an assessment based on fish tissue concentrations. Because of this higher degree of uncertainty, it is not sufficiently protective to utilize a cleanup level that has a low margin of safety, such as the proposed 450 μg/kg PCB cleanup level. At the 450 μg/kg cleanup level, both the estimated incidence of cancer and the Hazard Indices are at the high end of the acceptable range. A more restrictive (lower) cleanup level would be more protective of ecological health. (34, 11)*

**Response**: EPA agrees that the 450 μg/kg PCB SRAL falls at the high end of a range of cancer and non-cancer risks which EPA has determined to be acceptable for Superfund cleanups. EPA has now added a requirement that PCB concentrations in sediments must be reduced to 300 μg/kg within 10 years after remedial action. This will ensure that human health cancer risks are reduced by an additional 14 percent in the 10 years following remedial action. It should be noted, however, that all PCB cleanup levels examined from 450 to 150 μg/kg result in residual risks at the high end of EPA's risk range, due to the conservative scenario used for risk calculations (a high-end tribal fisher who fishes exclusively in the CB/NT area).

If EPA's analysis had shown that cleanup to the 1989 PCB SQO of 150 μg/kg would result in a significantly smaller risks to humans or wildlife, and that such a cleanup was cost-effective, EPA would agree that lower PCB cleanup level in the 1989 ROD should be retained. However, EPA's analysis shows that residual ecological risks at the revised SQO of 300 μg/kg PCB are not significantly higher than the risks associated with cleanup to a 150 μg/kg PCB SQO under the 1989 ROD. See Tables 1 through 6 of the ESD (EPA, 1997a) for a comparison of the estimated risk values at current conditions, at the ROD PCB cleanup level, and at the new PCB SQO of 300 μg/kg and SRAL of 450 μg/kg.

*5.1.2 Although below the 2LAET (second lowest Apparent Effects Threshold) of 1000 μg/kg, the proposed cleanup level of 450 μg/kg is significantly higher than the LAET of 130 μg/kg, which is the target sediment quality value set by the State of Washington Sediment Management Standards. As stated in previous comments, the proposed cleanup level of 450 μg/kg is also significantly higher than the median effects range (ER-M) concentration of 180 μg/kg. The ER-M is calculated from a national database of benthic invertebrate studies where more than half of the studies showed adverse effects to benthic invertebrates. (24)*

**Response**: Even if this decision were being made under the State of Washington Sediment Management Standards (SMS), meeting the lowest apparent effects threshold (LAET) of 130 μg/kg PCBs is not an absolute requirement under the State law. EPA and the State have the discretion to chose cleanup values that fall between the range of cleanup values set in the SMS, based on several factors, including cost-effectiveness. The Washington Department of Ecology concurs with EPA's modification of the PCB cleanup level. See EPA's response to Comment 1.6.1 for a discussion of the ER-M, and to 2.1.1 for further discussion of the SMS.

*5.1.3 EPA's risk assessment presents contrary views in the risk assessment uncertainties section in the ESD, which states: "The assumption used in the ecological risk evaluation will overestimate the exposure of species or individuals with large foraging ranges (such as migratory birds) and may underestimate the exposure of resident species that preferentially feed at a specific location." How was it determined that this methodology is therefore both "appropriate" and protective of human health and the environment when in the uncertainties* *section it clearly states the proposed action may not be protective for resident fish and wildlife species. (35)*

**Response**: EPA believes that its ecological risk evaluation (Weston, 1997a) is conservative with respect to protection of ecological receptors, including resident species. While the CB/NT Site-wide risk estimate may underestimate risks to resident species because PCB concentrations are averaged over the entire Site, the Waterway-specific risk assessments for the Hylebos and Thea Foss waterways provide conservative estimates of risks to resident species which preferentially feed in a particular Waterway. The referenced statement has been clarified in the final ESD. See responses to Comments 4.5.2 and 4.5.4 for further discussion.

*5.1.4 The ecological risk evaluation presented in the Addendum (Weston, 1997a) states that there will be an increased risk to fish and birds as a result of weakening the cleanup standards. The hazard index used to determine risk to these creatures shows that young salmon and fish-eating birds will be exposed to an unacceptable level of PCBs at the proposed 450 μg/kg cleanup level. (8)*

**Response**: The analysis in the 1997 Weston report shows that there is little difference in the calculated risks at the three cleanup levels examined (150 to 450 μg/kg PCBs). All of the cleanup levels examined represented a safe level for fish and birds (i.e., hazard quotients are at or near 1.) (It should be noted that EPA did not use the eagle analysis in the Weston report or the FWS letter for decision-making purposes due to uncertainties associated with the biomagnification factor and the lack of data on the foraging range of eagles in the area.) In addition, cleanup of other contaminants of concern and natural recovery processes will further reduce the risks to these receptors.

*5.1.5 Even under this averaging approach, the 450 μg/kg cleanup level will not be protective of fish and birds. The Record of Decision states that a 10-year goal of 150 μg/kg will result in an average concentration of 30 μg/kg in the bay and in the Hylebos Waterway (ROD, Section 7.1.4.). In a recent public testimony, the US Fish and Wildlife Service stated that a strengthening of the PCB cleanup standard is what is needed to protect fish-eating birds. However, under EPA's 450 μg/kg proposal, in ten years the average for the bay will be 63 μg/kg (no information was given about the Hylebos Waterway). The 450 μg/kg proposal will result in over twice the amount of PCBs in the bay. (8, 26, 36, 3)*

**Response**: EPA based its evaluation of ecological risks presented in the Addendum (Weston, 1997a) on reasonable maximum exposures to ecological receptors. As discussed in response to Comment 4.5.2, EPA believes an adequate degree of conservatism was applied and that the proposed PCB SRAL of 450 μg/kg is protective of ecological receptors at the CB/NT Site.

Additionally, the residual sediment PCB concentration after cleanup to 450 μg/kg will be further reduced over time through natural recovery. EPA has added a requirement in the final ESD that PCB concentrations must be reduced to a minimum of 300 μg/kg within 10 years after remedial action, to ensure that PCB concentrations will be reduced over time. Additional cleanup will be done if PCB concentrations are not reduced to 300 μg/kg after 10 years.

*5.1.6 EPA's own guidance calls for a cancer risk rate of no more than 100 in 1,000,000 yet EPA's cancer risk assessment predicts a cancer risk rate of 140 in 1,000,000 after the proposed cleanup at 450 parts per billion. EPA has the authority to require a cleanup level that will at least provide a cancer risk rate of 1 in 1,000,000. This decision barely met the 1 in 10,000 criteria, but EPA is willing to go ahead and judge it acceptable. You have hazard indices that do not meet the ratio of one, but EPA chooses to ignore those and decided the ecological effects were acceptable. (8, 26, 36, 3)*

**Response**: To meet EPA's criterion for protectiveness of human health, cleanup actions must result in risks on the order of $10^{-4}$ to $10^{-6}$ or lower. EPA policy states that the upper boundary of the risk range is not a discrete line at 1 x $10^{-4}$, and cleanups to levels slightly greater than 1 x $10^{-4}$ may be considered acceptable if justified based on site-specific conditions. For non-cancer health impacts, EPA's Superfund regulations do not contain a numeric standard, but state that EPA must achieve cleanup levels to which humans may be exposed without adverse effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Cleanups must also be protective of ecological receptors. EPA believes this decision meets these standards, especially due to the conservative assumptions built into the human health and ecological risk assessments. Furthermore, risks will be further reduced over time due to natural recovery processes.

*5.1.7 The Environmental Protection Agency is supposed to do just that: protect the environment. EPA's current proposal will not provide the best protection of the environment or to the people of the Commencement Bay community. EPA's position is unacceptable because the stakes are simply too high. The viability of wildlife populations, the survival of economies and cultures which rely upon them, and the health and intelligence of our children are all at stake. (36, 8)*

**Response**: EPA's primary criterion in any Superfund cleanup decision is protection of human health and the environment. EPA's 300 μg/kg PCB SQO meets that standard, as did the 150 μg/kg PCB SQO in the 1989 ROD. Either level results in a major decrease in the human health and ecological risks currently present at the site immediately after cleanup, with further reductions over time due to natural recovery. In fact, EPA's decision here will result in the most stringent PCB sediment cleanup of any appreciable size anywhere in the United States. Most Superfund sediment cleanups elsewhere have set PCB cleanup standards of 1,000 μg/kg or higher. Commencement Bay will be protected to a greater degree than any other major Superfund site in the country.

*5.1.8 The agency fails to recognize that cleanup issues are matters of civil rights. EPA weighs the costs of cleanup born by those who made the mess to begin with against the costs to be born by others. Instead of standing up for a clean environment for all, it treats polluters and their victims as equal "stakeholders," and it reopens a remedial action plan at the request of polluters to save them money. Trampled in the process is a simple justice—the right each person has to a clean environment. The civil rights issue is heightened by the fact that many Native Americans, Asian Americans and low-income people eat comparatively large quantities of fish each year, thereby suffering disproportionate exposures. EPA's oft stated commitment to environmental justice rings hollow when it ignores the environmental racism and injustice inherent in a recommendation to weaken cleanup standards. (36)*

**Response**: EPA must make cleanup decisions that are protective of human health and the environment. EPA strives to protect human health by identifying those individuals among all affected people at the Site who have some of the highest current or potential future exposures to contaminants at a site. In the vicinity of the CB/NT Site, EPA acknowledges that there are some populations who are likely to be exposed to greater than average amounts of CB/NT PCBs because they consume greater than average amounts of CB/NT fish. In the Addendum (Weston, 1997a), EPA considers risks to high-end tribal fishers to represent a reasonable maximum exposure scenario on which to base its reevaluation of the PCB cleanup level.

EPA does not believe environmental justice is incompatible with its commitment to selecting cost-effective cleanup solutions for Superfund sites. EPA's 450 $\mu$g/kg PCB SRAL was selected to be protective of who may rely on Commencement Bay fish for an important portion of their diet, and also allows for a cost-effective cleanup.

## 5.2 Comments related to the application of balancing criteria

*5.2.1 Six Superfund projects have completed remedial dredging to-date (Waukegan Harbor, Sheboygan River, GM Central Foundry, Bayou Bonfouca, New Bedford Harbor, and Marathon Battery.) Volumes of sediment removed ranged from 3000 cy to 159,000 cy. Overall costs ranged from $140 to $1430 per cubic yard, with an average of about $700 per cy. For three of the six projects, the cost does not include final disposal, which hasn't occurred at the Sheboygan River, GM Central Foundry, or New Bedford Harbor. How does EPA justify estimating an average cost as low as $73 per cy (Table 6, $18 million)? (1)*

**Response**: EPA used a cost estimate of $35 per cubic yard for dredging and disposal of contaminated sediments. This estimate is based on a June 26, 1996, report prepared by Hartman and Associates and other consultants to the Hylebos Cleanup Committee entitled "Hylebos Waterway Pre-Remedial Design Preliminary Disposal Site Evaluation." The report was reviewed by EPA, the U.S. Army Corps of Engineers, and EPA's contractor, Roy F. Weston, Inc. This estimate is also based on experience with the Sitcum Waterway sediment remediation project, which was completed in 1994.

The six projects cited have significantly different situations and features than the Hylebos Waterway, or other problem areas within the CB/NT Site. Costs associated with dredging projects are extremely equipment- and location-specific, making it very difficult to reasonably compare costs among different projects unless the specific project requirements and features are compared. PCB contamination levels for the referenced projects are significantly higher than at the CB/NT Site. Many of the projects listed in the comment have proposed some sort of sediment treatment option, either incineration, low temperature thermal desorption, or fixation/stabilization; and confinement of some type, generally using upland disposal methods. All of these remedial options require operational, equipment and handling methods which add significant costs to these projects, compared to the CB/NT Site. In addition, the New Bedford project included items such as water treatment, and the Sheboygan project included upland sediment storage, armoring and stabilization, none of which is included in the CB/NT cleanup plan. The CB/NT cleanup plan includes capping or dredging and disposal of contaminated sediment in an upland or aquatic disposal facility. Because contaminant concentrations are low compared to other contaminated sites, it is not anticipated that specialized equipment, sediment treatment, water treatment, or special handling will be needed to protect water quality during cleanup. These items justify a significantly reduced unit price estimated for the CB/NT project, compared to the other projects.

*5.2.2 EPA's Fact Sheet states that long-term effectiveness of the cleanup, reduction of toxicity, and short-term effectiveness would be affected by the proposed modification. The modification would increase risks to the marine environment, wildlife, and public health, especially through exposure pathways associated with remaining concentrated "hot spots" of 450 μg/kg PCB. In addition, Tribal and community opposition has been documented. In exchange for these impacts, cost would be reduced. We believe that this is an unbalanced and unacceptable exchange, and that consideration of all the remedy selection criteria do not support the proposed modification and that cost considerations discussed in the Fact Sheet are inappropriate in this case, given the delays in implementing the 1989 ROD cleanup plan. (28, 3, 8, 9, 36)*

**Response**: EPA agrees that if increasing the PCB cleanup level had a significant impact on toxicity and short- and long-term effectiveness, a modification solely based on cost would not be justified. The PCB cleanup level was changed only because EPA's analysis showed that the reduction in toxicity and long-term effectiveness and any increase in risks to the marine environment, wildlife, and the public health will be small. In the analysis of short-term effectiveness, the 450 μg/kg SRAL ranks higher than the original cleanup standard because short-term impacts to the waterway during dredging are reduced as the volume of sediments to be remediated are reduced.

*5.2.3 We are concerned with how the nine different and often conflicting criteria the EPA uses were each weighed and considered during the decision-making process. Attempts to avoid costs at this stage of the cleanup by implementing a less stringent cleanup effort may cost the* *public a greater expense at a later date. Specifically, these long term costs to our natural resources from chemical contamination would likely include: diminished returns of healthy salmon and other fish species, and decreases in breeding bird populations in the Bay. (35)*

**Response**: The nine criteria EPA uses to evaluate and select Superfund cleanup actions are not weighted equally. The first two criteria, protection of human health and the environment and compliance with applicable, or relevant and appropriate requirements, are threshold criteria which must be met under all circumstances. CERCLA has some provisions for waivers of other laws, but includes no waivers for the requirement of protectiveness. The next five criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost, are considered balancing criteria. EPA strives to achieve the best balance of these criteria in remedy selection. The last two criteria, state and community acceptance, are modifying criteria. EPA may modify its decision based on these criteria.

With regard to the ecological concerns mentioned in the comment, EPA must meet the threshold criterion of protection of humans and wildlife in selection of the PCB cleanup level. When EPA's analysis shows, as it did in this case, that a range of PCB cleanup levels would meet the criterion for protectiveness, we use the other criteria to help select the cleanup level that provides the best balance of the remedy selection criteria.

### 5.3 Comments related to natural recovery

*5.3.1 What is the mechanism that will cause the natural recovery? Is it due to gradual burial with clean sediments, in which case only the PCB availability at the sediment surface is being reduced? Is it due to dechlorination? If yes, what rate of dechlorination has been assumed? Is it due to a continuing PCB flux from the sediment into the water column and subsequent transport out of the waterway? (1)*

**Response**: Natural recovery of PCBs at the CB/NT Site will occur primarily because of burial by clean sediments (sources include the Puyallup River sediment load and small streams entering the waterways). Dechlorination processes are extremely slow and sediment flux to water is negligible because of the binding of PCBs to sediment carbon. In assessing the potential for natural recovery of PCBs at the CB/NT Site, EPA assumed there would be no biological or chemical degradation of PCBs, and that all natural recovery would be due to burial and mixing with clean sediments.

Natural recovery is determined for surface sediment as represented by the biologically active zone (top 10 cm). This is the stratum where most of the sediment-dwelling organisms that serve as prey to fish live. Receptors of concern are not exposed to deeper sediment.

*5.3.2 Use of the 1989 standards will allow for corrective measures and, based on monitoring to ensure that natural recovery is occurring, will make sure we collect all of the PCBs still trickling into the sound. (3)*

**Response**: Regardless of which PCB cleanup level is chosen, long-monitoring of sediments will occur following cleanup to ensure that contaminant concentrations remain at acceptable levels. In addition, EPA has added a requirement to the ESD that PCB concentrations must be reduced to 300 μg/kg within ten years of the remedial action. This means that long-term monitoring of PCB-contaminated sediments will be required to ensure that this standard is met. Finally, control of ongoing sources of contamination is required under the 1989 ROD, and will continue to be an integral part of the CB/NT cleanup.

*5.3.3 Since the proposed 450 μg/kg cleanup level is based on no natural recovery, EPA should not use natural recovery to assess the level of protectiveness that will be achieved by that cleanup level. (8)*

**Response**: EPA believes it is appropriate to use natural recovery to assess the protectiveness of the remedy, because we have added natural recovery as a required element of the remedy in the ESD. In response to public comments, and those of the State, EPA has modified the remedy as proposed in the March, 1997 draft ESD (EPA, 1997a) to include a PCB cleanup standard for natural recovery. If PCB concentrations in sediments do not naturally recover to at least 300 μg/kg within 10 years after the remedial action, EPA will take additional measures to achieve this concentration. Natural recovery modeling done to date indicates that, after source control is complete and sediments are remediated to 450 μg/kg PCBs, sediment PCB concentrations will be reduced to even lower than 300 μg/kg within 10 years.

*5.3.4 The ROD provides natural recovery rate estimates for the Hylebos. The HCC is required by the AOC to develop an updated natural recovery rate analysis for the Hylebos. The natural recovery rate can be used to show areas of the Hylebos that will recover to below the 450 μg/kg PCB cleanup level in ten years. EPA should not conclude that natural recovery to 450 μg/kg is not appropriate for PCBs prior to reviewing the natural recovery analysis that EPA required the HCC to conduct under the AOC. (17)*

**Response**: EPA agrees that natural recovery should be included as part of the remedy, but disagrees that 450 μg/kg should be the 10-year standard. EPA's SRAL of 450 μg/kg PCBs is at the high end of the risk range considered acceptable to EPA. If EPA allowed for natural recovery to 450 μg/kg, PCB concentrations in the interim 10-year period would be unacceptably high. EPA did consider natural recovery in its original proposal, in the sense that we acknowledged that one of the reasons it was acceptable to select a cleanup level at the high end of EPA's risk range, was that risks would be reduced over time through natural recovery. In the final ESD, EPA has added a requirement that sediments must naturally recover to 300 μg/kg PCBs within

10 years after cleanup. This will ensure that if sediments do not naturally recover, additional cleanup work will be done to ensure that a 300 μg/kg PCB cleanup level is achieved.

*5.3.5 Weston states that natural recovery will further reduce PCB concentrations in the sediment, but does not address the uncertainty associated with natural recovery itself. (35)*

**Response**: EPA agrees that there is uncertainty associated with natural recovery estimates. A complete analysis of natural recovery potential at the CB/NT Site was not conducted for the reevaluation of the PCB cleanup level. Instead, EPA relied upon the natural recovery estimates in the 1989 CB/NT ROD.

In the revised ESD, EPA has added a requirement that sediments must naturally recover to at least 300 μg/kg PCBs. Even though EPA has not attempted to quantify uncertainties associated with natural recovery estimates, we believe an estimate of natural recovery to 300 μg/kg is conservative because it falls at the high end of the range of estimated natural recovery rates for PCBs in the Hylebos Waterway. Using natural recovery rates in the ROD, sediments are predicted to naturally recover to 280 to 225 μg/kg PCBs following cleanup to 450 μg/kg. Additional natural recovery modeling will be required as part of pre-design work to verify the estimates in the 1989 ROD.

## 5.4 Comments related to current contamination and source control

*5.4.1 EPA has failed to produce results on controlling ongoing sources of PCBs in Commencement Bay showing an even more feeble approach to PCB cleanup. The National Marine Fisheries Service study states that the health of the bay has not improved in the last ten years. Can EPA demonstrate that the next ten years will be any better? (8)*

**Response**: Source control activities have been ongoing at the CB/NT site since the Record of Decision was signed in 1989. Ecology is responsible for working with individual facilities to achieve source control. For the Hylebos Waterway, Ecology has inspected or investigated 141 potential sources of contamination and have identified 26 ongoing sources. Ecology has worked with each of these facilities to control their sources, either through upland cleanups or implementation of best management practices. Of the 26 ongoing sources identified by Ecology, 21 have been controlled as of July 1997. Ecology plans to have all ongoing sources of contamination controlled (except intertidal areas, as discussed below), by mid-1998.

One of the significant sources of contamination remaining in the Hylebos Waterway is the intertidal sediments. These sediments contain the highest concentrations of PCBs and other chemicals found in the waterway. These intertidal sediments will act as sources of contamination to the rest of the waterway until they are remediated. Remediation of intertidal areas will occur either as part of Ecology cleanups or as part of the overall waterway cleanup. Additionally, subtidal sediments with high concentrations of PCBs act as continuing sources of PCBs through resuspension of sediments and movement to other parts of the waterways. However, after cleanup of areas where sediments exceed EPA's cleanup levels for PCBs and other contaminants, these sources of sediment recontamination will be removed, allowing for natural recovery to occur.

The NMFS study cited in the comment addresses current contamination in the Hylebos Waterway. See response to Comment 5.4.2 for a discussion of the results of this study.

*5.4.2 When recent toxicopathic results are compared to previous work done as part of the RI/FS, it is evident that conditions for flatfish (based on lesion prevalence and biochemical measures of early response to contaminant exposure) in the waterway have not measurably improved. This fact is significant as EPA is espousing a cleanup level three times higher than that originally stated in the ROD with the supporting rationale that natural recovery would be expected to occur (allegedly decreasing the concentration of PCB's in half over a 10 year period). The effects of natural recovery, since the RI data was collected (more than 10 years ago) have not been observed. (24, 8, 36)*

**Response**: The NMFS study cited in the comment evaluates current conditions in the Hylebos Waterway. EPA agrees that those and other studies show that natural recovery has not significantly reduced PCB concentrations or toxic effects in the Hylebos Waterway in the last 10 years. However, these studies are not a good predictor of conditions in the Waterway in the 10 years after completion of the cleanup.

Many of the source control activities required by the ROD have been completed in the last three to four years, and some will be completed over the next year. As noted in the response to Comment 5.4.1, PCB-contaminated intertidal sediments, one of the major sources of PCB contamination remaining in the waterway, have not yet been remediated. Because source control is not complete and sediments containing high concentrations of PCBs have not been remediated, no appreciable natural recovery of PCBs has occurred to date in the Hylebos Waterway.

Once source control and sediment remediation is complete, conditions in the Hylebos Waterway will change substantially. The highly contaminated sediments which are currently subject to erosion and movement to other areas of the waterway will be removed and replaced by clean sediments. These clean sediments will continue to move about the waterway and further reduce contaminant concentrations in areas where low levels of PCBs were left in place, leading to an overall reduction of contaminant concentrations in the waterway. In addition, clean sediments from other sources such as Hylebos Creek and the Puyallup River will continue to enter the waterway and further reduce contaminant concentrations through burial and mixing. For these reasons, EPA believes there will be natural recovery of PCB-contaminated sediments after completion of the cleanup, even though it has not occurred in the 10 years since the ROD was signed.

*5.4.3 A recent study by the National Marine Fisheries Service in the Hylebos Waterway of Commencement Bay revealed elevated levels of PCBs in fish and links the presence of PCBs to altered sexual reproduction of flatfish. Fish-eating birds, such as bald eagles and blue herons, in the Commencement Bay area have high levels of PCBs in their embryos. The herons from Dumas Bay use Commencement Bay as their feeding grounds. Seven eggs were collected from a colony of great blue herons in Commencement Bay in 1988. Chemical analysis revealed that PCB concentrations surpassed the threshold level for adverse impacts. Last year, 5 more eggs were collected from the Dumas Bay great blue heron colony, and the levels of PCBs in some of the eggs were still at levels where FWS would anticipate adverse affects. Recently, we have also determined that a significant portion of birds from this colony feed in Commencement Bay and its waterways. (35, 8, 26, 36)*

**Response**: Please see responses to Comments 5.4.2 and 4.4.6.

*5.4.4 Hasn't scientific testing shown this area to be polluted and one of the most toxic spots for the last 15 years? (9)*

**Response**: EPA agrees that concentrations of chemical contaminants are unacceptably high at the CB/NT Site and present unacceptable risks to human health and the environment. This assessment is the basis of EPA's 1989 ROD which requires source control and sediment cleanups at eight contaminated sediment problem areas in the Commencement Bay tideflats.

## 5.5 Comments related to changing the ROD

*5.5.1 In other EPA regions, federal courts, at the behest of EPA, give great credence to ROD numbers and the idea they should be frozen in time, otherwise a plethora of other values could be proposed and the remedial process could be thwarted. It is interesting that when potentially responsible party(PRP)-sponsored cleanup numbers come along later which are less restrictive, this theory seems to be quickly abandoned. (11)*

**Response**: EPA has a policy of not reopening Records of Decision to incorporate regulations passed after the ROD is signed, unless necessary to ensure protectiveness, because of the potential for long delays in implementing cleanups if the basis of a remedy had to be continually reevaluated during the design and implementation phases. However, this does not mean that EPA will ignore new information which indicates that the remedy may not be cost-effective when coupled with evidence that it may be possible to dredge a smaller volume of sediments with no appreciable change in the protectiveness of the remedy.

EPA has also championed the policy of reevaluating old remedies when new information indicates that there may be a more cost-effective way to implement the cleanup. EPA will also reevaluate remedies when new information indicates that a remedy is not sufficiently protective. This is true for Superfund-financed as well as potentially-responsible-party-financed cleanups.

In addition, the new PCB cleanup number is not a PRP-sponsored number. See comments in Section 3.2 for information about PCB cleanup levels preferred by PRPs.

*5.5.2 The proposed modification, requested by several potentially responsible parties, sends the wrong message — if you delay cleanup long enough, you can weaken standards and cut your liability. (28)*

**Response**: EPA agrees that Superfund cleanups should be implemented as quickly as possible for a variety of reasons, the most important of which is to remove contamination from the environment as quickly as possible. Regardless of the length of time between development and implementation of a cleanup plan, EPA believes that it is appropriate to reevaluate a Superfund remedy if new information indicates that the original decision may be significantly flawed. This is true whether the remedy is being paid for through Superfund monies or if it is privately funded.

## 5.6 Comments related to the role of parties outside EPA

*5.6.1 Ecology must abide by the 1989 ROD which established 150 μg/kg as the allowable level of PCBs in sediment. Will this mean a dual standard for cleanup of toxic sites in Washington State? Will a bill be submitted to the legislature demanding that state standards cannot exceed federal standards in any case? (3)*

**Response**: The 1989 ROD for the CB/NT Site is an EPA document, with concurrence by Ecology. Ecology has also concurred with EPA's decision to modify the ROD by issuing this ESD. The PCB cleanup standards set by this ESD of 450 μg/kg immediately after cleanup and 300 μg/kg within 10 years after cleanup were developed based on the site-specific circumstances at the CB/NT Superfund site, and applies only to the cleanup of that site. Ecology is not required to follow the CB/NT ROD or this ESD for setting sediment cleanup levels elsewhere in the state. Ecology has not yet set numeric standards for PCBs in sediments for protection of human health and may set standards that are more or less stringent that the standard set for the CB/NT Superfund site.

*5.6.2 Outside of the ecological concerns I also wondered if the state health department played any role in the PCB decisions? I am unable to find any record of their involvement or concurrence. (11)*

**Response**: The Washington State Department of Health (WDOH) was notified that EPA was considering modifying the PCB cleanup level for the CB/NT Superfund site in February 1996, and was given the opportunity to comment on Weston's first draft evaluation of potential alternative PCB cleanup levels. WDOH's comment letter is in the Administrative Record for this ESD.

*5.6.3 The businesses and the Port of Tacoma which stand to save $13 million dollars from EPA's proposal underestimate the long term impacts a decision in their favor would cause. (8)*

**Response**: See response to Comment 5.2.2.

### 5.7 Comments related to the remedial action

*5.7.1 We have serious reservations as to whether a remedial program for achieving the targeted cleanup level is either (1) feasible or (2) is at all predictable with regard to ultimate schedule and cost. No dredge or combination of dredges can consistently achieve a cleanup level of even several ppm. Please clarify EPA's position in this regard. (1)*

**Response**: In general, the achievement of the cleanup level via dredging is not predominantly a function of dredging technology itself but more a function of how much contaminated material exists and how much requires removal to achieve the cleanup objective. In most areas of Commencement Bay, sediment contamination is associated with overlying unconsolidated sediments. The underlying native sediments are, with a few exceptions, relatively free of contamination. Sediment cores have been used to identify the depth of contaminated material, which in many areas is only a few feet deep. EPA's experience with the St. Paul and Sitcum Waterway cleanups in Commencement Bay shows that cleanup to the Sediment Quality Objectives in the ROD is feasible, and with sufficient sampling, is predictable with regard to schedule and cost.

*5.7.2 The more than half century of industrial use of the Hylebos Waterway must have resulted in wide-spread and sizable quantities of debris disturbed and embedded on the bottom. Debris is detrimental to the efficient and continuous operation of a dredge. Debris, or rocks, was a serious problem at least four of the six Superfund sites mentioned in Comment 5.2.1. Has EPA assessed the debris problem? How would this problem be managed and overcome during the proposed dredging process? What would the disposition of the debris be? Have the substantial inefficiencies due to debris interferences, and management and disposal of debris, been included in the cost estimate? (1)*

**Response**: During the initial investigations of the Hylebos Waterway, a side-scan sonar survey was conducted to identify the quantity and location of subsurface debris. This survey showed that there is some metal debris and some sunken logs in the Hylebos Waterway, but the extent of debris was not as great as has been seen at other

Puget Sound dredging projects. A similar survey has not yet been conducted for the Thea Foss Waterway, but we have no reason to believe there would be more debris at Thea Foss than at Hylebos Waterway.

Dredging plans have not yet been developed for either waterway. These plans will include plans for handling and disposition of debris. The presence of debris is one of the factors to be used in determining the dredging method, as use of a clamshell dredge rather than a hydraulic dredge will minimize difficulties in handling debris. Regardless of the selected dredging method, the debris will most likely be handled and disposed of separately. It is not anticipated that debris handling will significantly impact the cost of the remedy.

*5.7.3 Is capping a candidate remedial technology for the Hylebos Waterway, or is the reference to capping inadvertent? Please explain the status of a capping remedy. (1)*

**Response**: Capping is one of the sediment confinement options selected in the 1989 ROD. However, capping is only appropriate in areas where there are no or limited navigational constraints and where the cap is not likely to be disturbed through erosion, scour, or future dredging. Capping is precluded in much of the Hylebos Waterway due to these constraints. However, it is being considered for some of the intertidal areas in the Hylebos Waterway and portions of the Thea Foss Waterway.

*5.7.4 The ESD acknowledges the benefit of having only one disposal site, rather than multiple disposal sites. One disposal site decreases the amount of area initially disturbed, decreases monitoring efforts, and also may decrease the likelihood of breach of containment. As pointed out in the "Explanation of Significant Differences...", pages 15 and 17, a cleanup volume greater than 700,000 cubic yards (cy) may require multiple disposal sites. Since the proposed cleanup level of 450 μg/kg would result in the removal of approximately 508,000 cy of contaminated sediments and the original cleanup level (300 μg/kg) would result in approximately 891,000 cy, it may be best to extrapolate the cleanup level based on 700,000 cy of contaminated sediment. This approach would provide a cleanup level that is more protective than the proposed 450 μg/kg concentration and yet should not increase the technical feasibility of the cleanup effort. (34)*

**Response**: Backcalculating a cleanup level based on volume limits is an interesting idea; however, it would require a fixed volume above which we will need multiple disposal sites. Since a disposal site has neither been selected nor designed for the remaining cleanups, at this time we only have estimates of the capacities of various disposal sites which are under consideration. The figure of 700,000 cubic yards mentioned in the ESD is merely an estimate of a volume over which multiple disposal sites are likely to be needed, because most of the sites under consideration have capacities of less than 700,000 cubic yards. Waiting for selection and design of a disposal site, then calculating a PCB cleanup level based on the capacity of that site, would cause a long delay in the cleanup.

## 5.8 Other Comments

*5.8.1 As a general concern, the documents released for public review did not address the EPA's authority to issue an explanation of significant difference. We would appreciate information on the regulatory framework for which an explanation of significance is allowed and appropriate. (8)*

**Response:** The implementing regulations for the Superfund law are contained in the NCP, which is codified at 40 CFR Part 300. Section 300.435(c) of the NCP sets out the procedures EPA must follow if, after the ROD is adopted, new information developed during the remedial design or remedial action, or an enforcement action, or consent decree, results in the remedial action differing significantly from the remedy selected in the ROD with respect to scope, performance, or cost. The NCP requires that a summary of the explanation of significant differences be published in a newspaper of general circulation, and that the explanation of significant differences and supporting documentation be placed in the Administrative Record for public review. Significant changes to a remedy are generally changes to a component of the remedy that do not fundamentally alter the overall remedial approach. Fundamental alterations to the ROD are considered changes which make the remedy no longer reflective of the selected remedy and, therefore, require an amendment to the ROD.

In this case, information collected during pre-design sampling indicated that the volume of sediments required to cleanup up to the PCB cleanup level in the ROD was significantly larger than originally anticipated. The ROD estimated that remediation of 448,000 cubic yards of contaminated sediments would be required in the Hylebos Waterway at an estimated cost of $13.8 million. Current estimates place this volume at 891,000 cubic yards and the cost at $31 million, mainly due to new estimates of the extent of PCB contamination. This, in itself, is a significant change in the scope, performance, and cost of the ROD. With this ESD, the amount of sediment requiring remediation will change to 508,000 cubic yards, at a cost of $18 million.
The revised PCB cleanup level significantly changes a performance standard established in the ROD, but does not significantly change the volume and cost of the cleanup as anticipated in the 1989 ROD. The remedial approach remains the same as outlined in the ROD (i.e., confinement of contaminated sediments that will not naturally attenuate below the cleanup levels within 10 years). Additionally, in this case, EPA chose to go beyond what the regulations require for public review of an ESD by informing the public of our proposed PCB cleanup level and taking public comment on that proposal before making a final decision.

*5.8.2 There is a connection between what you require in cleanup and pollution prevention. If you send the message with this cleanup that they can leave more there, you are sending a message to everyone that continued pollution — you may not be held accountable for continued pollution. (36)*

**Response**: EPA agrees that the Superfund law and its requirements for cleanup of contamination send a strong message that pollution carries with it a high cost. With the PCB SRAL set at 450 $\mu$g/kg, PRPs will be required to dredge approximately 500,000 cubic yards of sediments at a cost of $18 million for the Hylebos Waterway. Polluters are still getting a message that there is a significant cost associated with pollution of the CB/NT Superfund site.

*5.8.3 I am also concerned as to how these levels may be used in negotiations with potentially responsible parties to lessen the footprint of contaminated sites, thereby reducing damage assessment calculations. (11)*

**Response**: Natural Resource Trustees assess damage to natural resources independently of EPA's efforts to define a cleanup area. EPA's selection of a PCB cleanup level and associated footprint of a cleanup area should not affect the Trustee's ability to recover costs for damage to natural resources.

*5.8.4 This action by EPA appears to be cost driven, with little publicity, an abbreviated response time, and limited participation. Tahoma Audubon Society did not receive a notice and there was no published notice in the News Tribune, leading me to wonder how wide the contact was. I believe that one newspaper article appeared on the subject. Finally two weeks from the public hearing to the response deadline is a very short time for such a complex subject. (3)*

**Response**: EPA's efforts to inform and involve the public in this decision are described on page 2 of this responsiveness summary. EPA sent fact sheets to over 2,000 people to announce a 30-day public comment period on the proposed ESD, which ran from March 10 through April 9, 1997. On March 10th, the beginning of the comment period, a display advertisement was placed in the *Tacoma News Tribune* announcing EPA's proposal, the comment period, and the date of the public meeting, which was held on March 26. These efforts are consistent with or greater than EPA's practice at other Superfund sites.

EPA has added this commentor to our Commencement Bay mailing list. Others who would like to be on EPA's mailing list to receive fact sheets on the CB/NT Site, are welcome to contact Jeannie O'Dell at (206) 553-6919 to ask to be added to the mailing list.

## Part III—List of Commentors

### HYLEBOS PCB COMMENT SUMMARY RESPONDENTS

| Abbreviated Reference | Full Reference |
|---|---|
| 1 | Applied Environmental Management, Inc. |
| 2 | Agency for Toxic Substances and Disease Registry |
| 3 | Tahoma Audubon Society |
| 4 | Bay Zinc Company, Inc. |
| 5 | Bonneville Power Administration |
| 6 | Graham & James LLP/Riddell Williams P.S. representing the Buffelen Woodworking Company |
| 7 | Byrd Real Estate Services, Inc. |
| 8 | Citizens for a Healthy Bay |
| 9 | Individual Citizens |
| 10 | City of Tacoma |
| 11 | Washington Department of Ecology (as Natural Resource Trustee) |
| 12 | Washington State Department of Health |
| 13 | Dunlap Towing Company |
| 14 | Floyde & Snider, Inc. |
| 15 | F.O.F., Inc. |
| 16 | Gradient Corporation |
| 17 | Hylebos Cleanup Committee |
| 18 | Hylebos Marina |
| 19 | Manke Lumber Company |
| 20 | Mintercreek Development |
| 21 | Modutech Marine, Inc. |
| 22 | Murray Pacific Corporation |
| 23 | Middle Waterway Action Committee |
| 24 | National Oceanic and Atmospheric Administration |
| 25 | PALS Investments |
| 26 | People for Puget Sound |
| 27 | Petroleum Reclaiming Service, Inc. |
| 28 | Puget Soundkeeper Alliance |
| 29 | Puyallup Tribe of Indians |

# HYLEBOS PCB COMMENT SUMMARY RESPONDENTS

| Abbreviated Reference | Full Reference |
|---|---|
| 30 | Joseph Simon & Sons |
| 31 | Steich Brothers Machine Works |
| 32 | Bucknell Stenlik representing Taylor Way Properties, Inc. |
| 33 | Tacoma Pierce County Chamber of Commerce |
| 34 | Tacoma-Pierce County Health Department |
| 35 | U.S Fish and Wildlife Service |
| 36 | Washington Toxics Coalition |

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## E. GLOSSARY OF TERMS

**Apparent Effects Threshold:** A chemical concentration above which deleterious biological effects are predicted to always occur.

**Arithmetic mean:** In testing, the same as ordinary average determined by adding all the scores and dividing the sum by the number of scores in the group. The resulting quotient is the average or mean.

**Aroclors:** Industrial mixtures of polychlorinated biphenyl compounds.

**Bathymetry:** A topographic map of the bed of the ocean.

**Biomagnification factor (BMF):** A factor describing the degree of accumulation of an organic chemical taken up from an environmental medium in a living organism.

**Biota-sediment accumulation factor (BSAF):** A factor describing the rate of transfer of an organic chemical from sediment to an organism.

**Cancer slope factor (CSF):** A term used to describe the adverse cancer effects of a contaminant. CSFs are measured by the probability of a person developing cancer over a lifetime.

**Endocrine disrupter:** An agent that interferes in some way with the natural hormones in the body (e.g., those secreted by the pituitary, thyroid, pancreas, adrenal, testes and ovaries). An agent might disrupt the endocrine system by affecting any of the various stages of hormone production and activity.

**Geometric mean:** That value obtained by multiplying all the items of a series together and extracting the *nth root* of this product, where *n* is the number of items.

**Hazard quotient:** A ratio comparing a chemical concentration in an environmental medium (e.g., sediment) to a toxicity threshold value or criterion. A result greater than 1 indicates an exceedance of the threshold or criterion.

**$K_{ow}$:** A laboratory measure of the partitioning of a chemical between *n*-octanol and water. It provides a measure of the water solubility of a chemical.

**Lognormal:** A statistical distribution of an environmental variable (e.g., chemical concentration) in which lower values are more frequently encountered. The central tendency (or middle) of the distribution tends to be lower than that estimated by an arithmetic mean and is often estimated by the geometric mean.

**Microtox:** A commercial bioassay test measuring changes in bioluminescence in a bacterium in response to contaminant exposure.

**Organic carbon normalized:** Expression of a dry-weight chemical concentration in terms of parts of organic carbon. Derived by dividing a chemical concentration by the decimal fraction of organic carbon in the sediment.

**Parts per Billion (ppb):** Parts of a chemical (e.g., PCBs) per billion parts of an environmental medium (e.g., fish tissue). May be expressed as μg/kg.

**Parts per Million (ppm):** Parts of a chemical (e.g., PCBs) per million parts of an environmental medium (e.g., fish tissue). May be expressed as mg/kg.

**Pathogens:** Microorganisms that can cause disease in other organisms or in humans, animals and plants (e.g., bacteria, viruses, or parasites) found in sewage, in runoff from farms or rural areas populated with domestic and wild animals, and in water used for swimming. Fish and shellfish contaminated by pathogens, or the contaminated water itself, can cause serious illness.

**Potentially responsible parties (PRPs):** Any individual or company—including owners, operators, transporters or generators-potentially responsible for, or contributing to, a spill or other contamination at a Superfund site.

**Reasonable maximum exposure (RME):** The highest exposure reasonably expected to occur in a population.

**Reference dose (RfD):** The concentration of a chemical known to cause health problems; also can be referred to as the ADI, or acceptable daily intake.

**Total organic carbon:** Carbon derived from a living or decomposing material that has been incorporated into a sediment matrix.

**Trophic level:** A step along the food chain from numerous small organisms to decreased numbers of large organisms.

**μg/kg:** Micrograms of a chemical (e.g., PCBs) per kilogram of an environmental medium (e.g., fish tissue); also expressed as parts per billion or ppb.

**mg/kg:** Milligrams of a chemical (e.g., PCBs) per kilogram of an environmental medium (e.g., fish tissue); also expressed as parts per million or ppm.